The influence of lexical meaning and prior belief on projectivity*

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Abstract

Projective content, like presuppositions or conventional implicatures, is utterance content that a speaker may be taken to be committed to even when the expression associated with the content occurs embedded under an entailment-canceling operator (e.g., Chierchia and McConnell-Ginet 1990). It has long been observed that non-entailed content may also be taken to be a commitment of the speaker when the expression associated with the content is embedded under such operators (e.g., Simons 2001; Schlenker 2010; Simons et al. 2017). Some authors, like Anand and Hacquard 2014, assume that speaker commitment in such cases is a different phenomenon/should be given a different analysis ("illusion of factivity" and "illusion of projection"), whereas others, like Schlenker 2010 talks of "part-time triggers". Former authors assume that entailed content = presupposition, and non-entailed content = something else. Entailment is a binary property but is it really the way in which language users treat it?

The goal of this paper was to investigate whether projectivity is influenced by entailment and by the prior probability of the event described by the projective content.

We show that...and that....

1 Introduction

- Tonhauser, Beaver, and Degen ms found that lexical content of projective content matters for projection.

- Presuppositions are entailed content that is projective, i.e., that a speaker may be taken to be committed to even when the expression that the presupposition is associated with occurs under an entailment-canceling operator.

- So projective content is often assumed to be entailed.

- But we know that not only entailed content may be projective.

- Entailment

    - Entailment is a relation between two statements: A entails B if and only if every model in which A is true is also one in which B is true.
      A sentence (meaning) A entails B if whenever A is true, then B must also be true.
      Entailment is assumed to hold no matter what the facts of the world are.

    - Chierchia and McConnell-Ginet 1990:19f. "A entails B =df whenever A is true, B is true [...]
      A and not B is contradictory (can't be true in any situation)"

– Schlenker 2010

> (1)　a.　Context: Mary is a responsible 30-year old.
> Mary has announced to her parents that she is pregnant.
> it follows: Mary is pregnant　　　　　　　　　(Schlenker 2010:139)
>
> b.　Context: Mary is playful 7-year old.
> Mary has announced to her parents that she is pregnant.
> it does not follow: Mary is pregnant　　　　　　(Schlenker 2010:140)
>
> c.　John has announced that he has met Elvis
> it does not follow: John has met Elvis.　　　　　(Schlenker 2010:140)

2　Norming study: Prior probabilities of events

[1]

2.1　Methods

Participants.　95 participants with U.S. IP addresses and at least 99% of previous HITs approved were recruited on Amazon's Mechanical Turk platform (ages: 21-75; median: 33; 45 female, 50 male). They were paid 55 cents for participating in the experiment.

Materials.　The prior probability of 20 events described by English sentences were explored in this experiment. Each of the 20 event descriptions was paired with two facts about the world, described by English sentences and labeled 'Fact:', for a total of 40 fact/event pairs. Each event was hypothesized to be relatively more likely given one of the two facts than given the other fact that the event was paired with. Two fact/event pairs are given in (2) for the event described by the English sentence *Mary is pregnant*: this event was hypothesized to be more likely given the fact described in (2ai) than given the fact described in (2bi). See Appendix A for the other 19 event descriptions and the fact descriptions that the event descriptions were paired with.[2]

> (2)　a.　i.　Fact: Mary is taking a prenatal yoga class
> 　　　　ii.　Mary is pregnant
> 　　b.　i.　Fact: Mary is a middle school student
> 　　　　ii.　Mary is pregnant

fact/event pairs were chosen so that neither at ceiling nor at floor. We need to avoid eventualities being too likely or too unlikely, given their two facts, because a) if they are too likely, then people might argue that the facts of the world entail the content of the clause describing the eventuality, and b) if they are too unlikely, then participants might give wonky projectivity ratings.

The experiment also included two control stimuli, which were used to assess whether participants were attending to the task. Like the target stimuli, both control stimuli consisted of a sentence describing a fact about the world and a sentence describing an event, as shown in (3) and (4). The two control stimuli differ in the probability of the event given the fact about the world: whereas the event of Barry living in Europe has a probability of 1, given the fact that Barry lives in Germany, the event of Tammy speaking Italian and Greek has a probability of 0, given that Tammy is a rabbit.

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[1]The data and R code for generating the figures and analyses of the norming studies and the experiment reported on in this paper are available at `https://github.com/judith-tonhauser/projective-probability`.

[2]Need to say that we use 'event' for events and states, rather than 'eventuality'.

(3)   i. Fact: Barry lives in Germany

          ii. Barry lives in Europe

(4)   i. Fact: Tammy is a rabbit

          ii. Tammy speaks Italian and Greek

The 40 target stimuli were distributed across two lists of 20 target stimuli each so that each list contained 20 unique event descriptions and each list included 10 fact/event pairs for which the event was hypothesized to be likely and 10 fact/event pairs for which the event was hypothesized to be less likely. The two control stimuli were added to each list, for a total of 22 stimuli per list.

Procedure. Participants were randomly assigned to a list. They were told that they would read a fact about the world and were asked to assess how likely a particular event was, given the fact. The 22 stimuli were presented in random order to each participant. On each trial, participants read the fact and the corresponding response question, which was formed from *How likely is it that...?* with the sentence describing the event realizing the embedded clause of the question. Participants gave their response on a slider marked 'impossible' at one end (coded as 0) and 'definitely' at the other (coded as 1), as shown in Fig. 1.

Figure 1: A sample trial in the prior probability norming study

After completing the experiment, participants filled out a short optional survey about their age, their gender, their native language(s) and, if English is their native language, whether they are a speaker of American English (as opposed to, e.g., Australian or Indian English). To encourage them to respond truthfully, participants were told that they would be paid no matter what answers they gave in the survey.

Data exclusion. Prior to analysis, the data from 8 participants who did not self-identify as native speakers of American English were excluded. For the remaining 87 participants, we inspected their responses to the two control stimuli (the group means were .86 for (3) and .03 for (4)). 19 participants gave responses lower than .8 to (3) or responses higher than .2 to (4), suggesting that these participants did not attend to the task or interpreted the task differently. The data from these 19 participants were also excluded, leaving data from 68 participants (ages 21-75; median: 36; 31 female, 37 male).

2.2   Results and discussion

As expected, likeliness ratings of events were influenced by facts about the world: overall, the mean likeliness rating for events presented with facts that make the event more likely was .7 (sd = .21) and the mean likeliness rating for events presented with facts that make the event less likely was .16 (sd = .17). Figure 2 shows the likeliness rating for the 20 events given facts that make the events more likely (brown dots) and
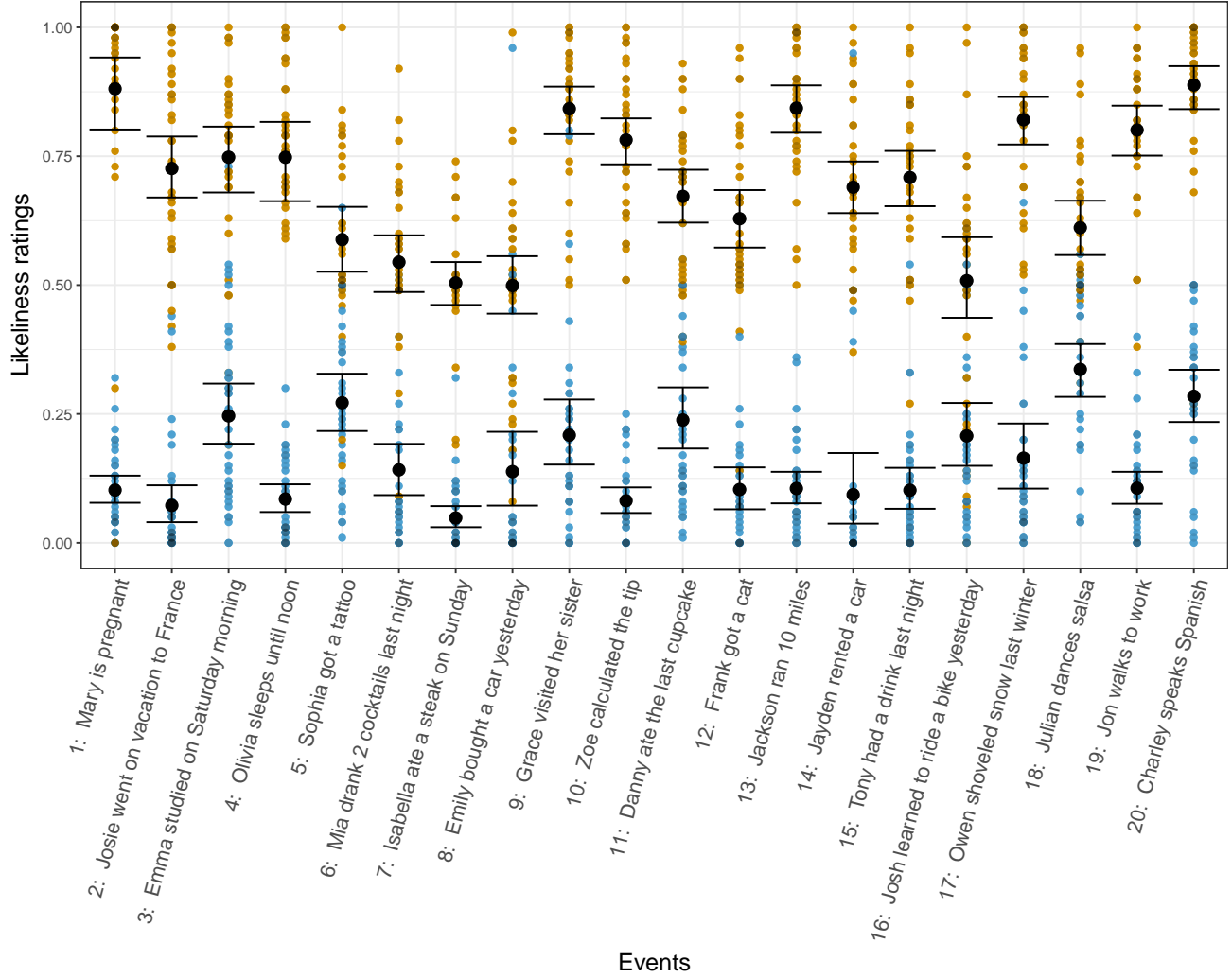
Figure 2: Likeliness ratings for 20 events given facts about the world that make the events more likely (brown dots) and facts about the world that make the events less likely (blue dots); darker dots indicate overlapping ratings. Mean likeliness ratings for the 40 fact/event pairs are given by black dots. Error bars indicate 95% confidence intervals.

facts that make the events less likely (blue dots). Mean likeliness ratings for each of the 40 fact/event pairs are shown as black dots. Error bars indicate 95% confidence intervals.

For each event, the likeliness of the event is higher given the fact that makes the event more likely than given the fact that makes the event less likely. At the same time, the likeliness of none of the events given a particular fact is at ceiling or at floor. We have thus succeeded in identifying suitable fact/fact/event triples for our study of how projectivity is influenced by event probability.

3 Veridicality

3.1 Methods

Participants.   300 participants with U.S. IP addresses and at least 99% of previous HITs approved were recruited on Amazon's Mechanical Turk platform (ages: 19-73, median: 33; 127 female, 169 male, 2 other, 2 didn't provide information). They were paid 75 cents for participating in the experiment.

Materials.   The veridicality of 20 predicates was explored in this experiment: *be annoyed, know, discover, reveal, see, establish, pretend, think, suggest, prove, demonstrate, say, hear, confess, inform, announce, acknowledge, admit, confirm* and *be right*.
   include info on why these were included
   400 sentences were formed by combining the 20 predicates with a (random) proper name subject and a complement clause that lexicalized one of the 20 events explored in the prior probability norming study described in section **??** (see Appendix A).[3] The target stimuli consisted of one of these 400 sentences followed by a *but I know that*-clause that denied the truth of the complement clause, as shown in the sample stimuli in (5). The speaker of the target stimuli was realized by a (bold-faced) proper name. The proper names that realized the speakers and the subjects of the 20 predicates, and that occurred in the complement clauses were all unique. The gender of the proper name subject of the predicate was distinct from the gender of the proper name in the complement clause, to ensure that the pronoun in the *but I know that*-clause unambiguously referred to the person referred to in the complement clause of the predicate.

(5)   a.   **Christopher:** Melissa knows that Danny ate the last cupcake, but I know that he didn't.
   b.   **Susan:** Jerry pretended that Emma studied on Saturday morning, but I know that she didn't.

The experiment also included eight control stimuli, which were used to assess whether participants were attending to the task. The four control stimuli in (6) were hypothesized to be non-contradictory, and the four control stimuli in (7) were hypothesized to be contradictory.

(6)   a.   Zack believes that I'm married, but I'm actually single.
   b.   Tara wants me to cook for her and I'm a terrific cook.
   c.   Frederick is both smarter and taller than I am.
   d.   Vanessa is really good at math, but I'm not.

(7)   a.   Dana has never smoked in her life and she stopped smoking recently.
   b.   Hendrick's car is completely red and his car is not red.
   c.   Madison laughed loudly and she didn't laugh.
   d.   Sebastian lives in the USA and has never been to the USA.

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[3]past tense, present tense, inform Sam

Each participant saw a random set of 28 stimuli: each set contained one stimulus for each of the 20 predicates (each with a unique complement clause) and the same 8 control stimuli. Trial order was randomized.

Procedure. Participants were told that they would read utterances made by a speaker and were asked to assess whether the speaker's utterance is contradictory. On each trial, participants read the speaker's utterance and then gave their response on a slider marked 'definitely no' at one end (coded as 0) and 'definitely yes' at the other (coded as 1), as shown in Figure 3.

Figure 3: A sample trial in in the veridicality norming study

After completing the experiment, participants filled out a short, optional survey about their age, their gender, their native language(s) and, if English is their native language, whether they are a speaker of American English (as opposed to, e.g., Australian or Indian English). To encourage them to respond truthfully, participants were told that they would be paid no matter what answers they gave in the survey.

Data exclusion. Prior to analysis, the data from 14 participants who did not self-identify as native speakers of American English were excluded. For the remaining 286 participants, we inspected their responses to the 8 control stimuli: we expected low responses to the non-contradictory stimuli in (6) and high responses to the contradictory stimuli in (7). The response means of 11 participants were more than 3 standard deviations above the group mean for the non-contradictory control stimuli or below the group mean for the contradictory control stimuli (the group means were .15 and .92, respectively).[4] Closer inspection revealed that these participants' responses to the control stimuli were systematically higher or lower, suggesting that these participants did not attend to the task or interpreted the task differently. The data from these 11 participants were also excluded, leaving data from 275 participants (ages 19-73; median: 35; 119 female, 153 male, 2 other, 1 didn't provide information).

3.2 Results

Figure 5 shows the contradictoriness ratings by predicate, collapsing over the 20 complement clauses that each predicate was paired with. As expected, the five predicates that do not entail the content of the com-

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[4]The response mean of one of the non-contradictory control stimuli, (6a) *Zack believes that I'm married, but I'm actually single*, was higher, at .36, than the response means of the remaining three non-contradictory control stimuli (which were .06, .07 and .09, respectively). We hypothesize that some participants gave a higher response to this stimulus because the speaker can be taken to contradict Zack's belief. If responses to this control stimulus are not considered, then the response means of an additional four participants are more than 3 standard deviations above the group response mean for the remaining three non-contradictory control stimuli (with the group mean at .08). **SAY WHETHER ANYTHING IN ANALYSIS CHANGES IF WE DO SO.**

plement, namely *pretend, suggest, think, hear* and *say*, have the lowest mean contradictoriness ratings. Furthermore, the predicate *be right* has the highest mean contradictoriness rating, thereby confirming the assumption that the content of its clausal complement is entailed.
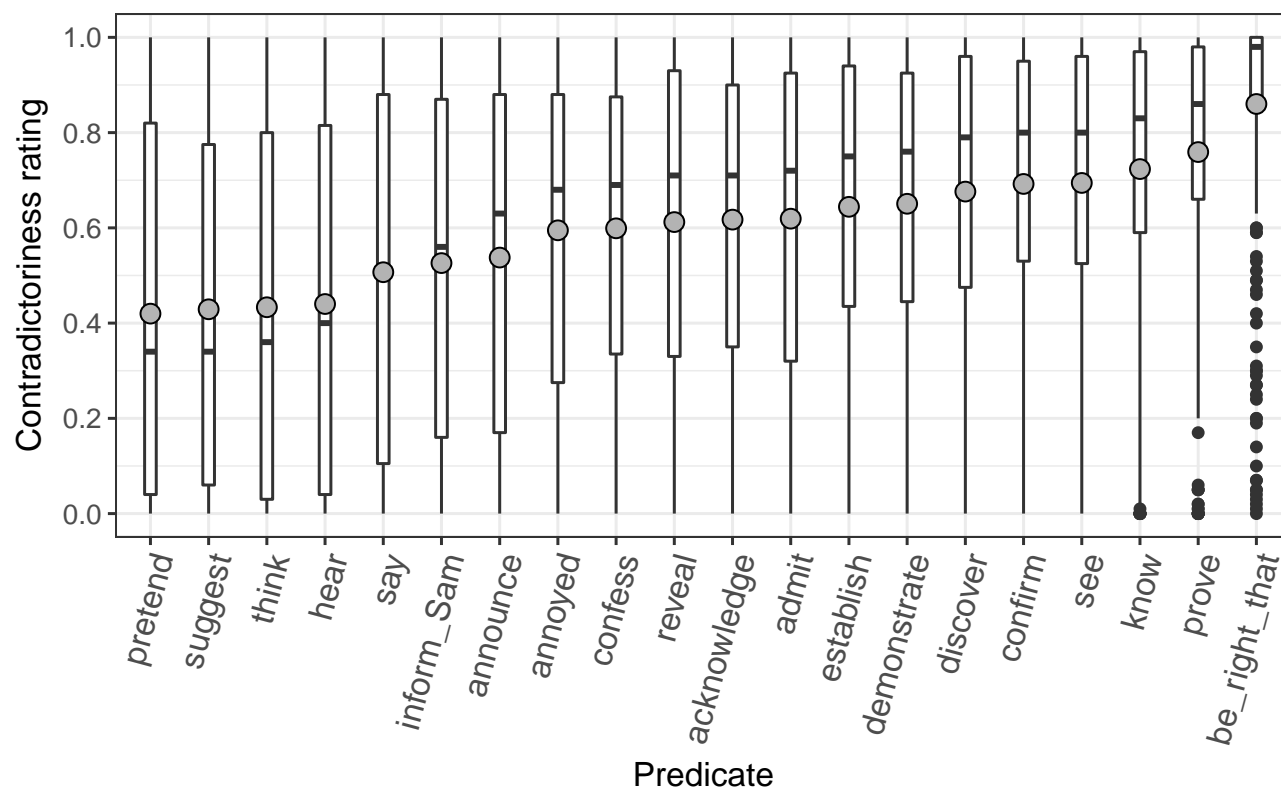

Figure 4: Boxplot of contradictoriness ratings by predicate, collapsing across complement clauses. Grey dots indicate means and notches indicate medians.
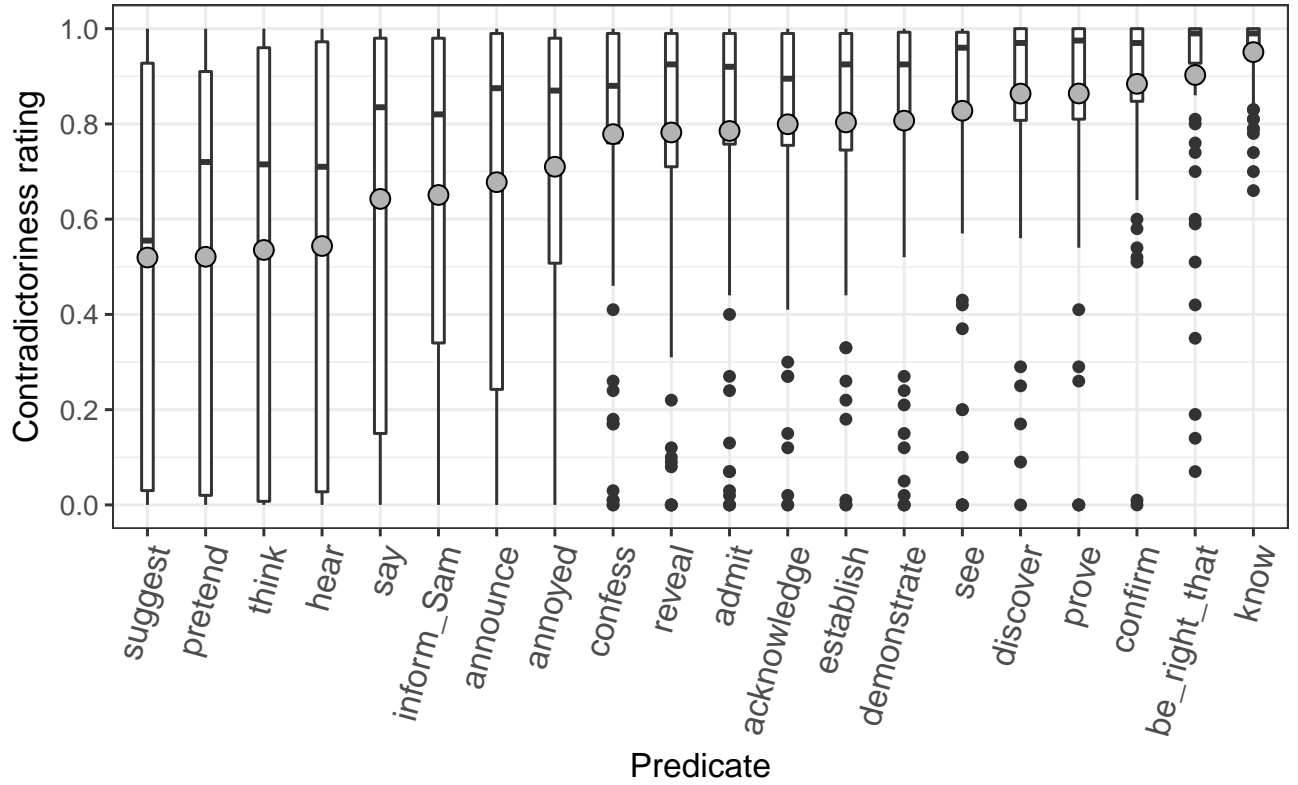
Figure 5: **data restricted to 80 participants who took know to entail content of complement** Boxplot of contradictoriness ratings by predicate, collapsing across complement clauses. Grey dots indicate means and notches indicate medians.

To determine which predicates differed from each other in veridicality, we conducted post hoc pairwise comparisons using Tukey's method (allowing for by-participant variability), using the `lsmeans` package (Hothorn et al., 2008) in R (R Core Team, 2016). P-values for each pair of predicates are displayed in Table 1. The color-coding of table columns indicates the standard assumptions about whether the content of the complement is entailed: predicates written in brown font are typically taken to not entail the content of the complement, predicates written in blue font are typically taken to entail the content of the complement, and predicates written in green font have been discussed as being easily taken to entail but don't really entail.

These results confirm commonly-made assumptions about entailment. First, the five predicates that are typically taken to not entail the content of the complement (*pretend, suggest, think, hear, say*) received significantly lower contradictoriness ratings than the seven predicates that are typically taken to entail the content of the complement (*annoyed, know, discover, reveal, see, establish, be right*). Furthermore, these results suggest that, of the five predicates that are typically assumed to not entail the content of the complement, all but *say* are significantly less veridical than *inform*, the least veridical of the entailed? predicates.

The results suggest no differences in the veridicality of the verbs of saying, *say, inform* and *announce*. The next set of predicates for which the results suggest no difference in veridicality consists of *be annoyed, confess, reveal, acknowledge* and *demonstrate*. This set of predicates consists both of predicates for which the content of the complement is typically taken to be entailed (e.g., *be annoyed*) and of predicates for which the content of the complement is not really entailed (e.g., *confess*). The next set consists of *discover, confirm* and *see*. Finally, *know* and *prove*, which are indistinguishable, and *be right*, which is significantly more veridical than all other predicates.

	pretend	suggest	think	hear	say	inform	announce	annoyed	confess	reveal	acknowledge	admit	establish	demonstrate	discover	confirm	see	know	prove
pretend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
suggest	n.s.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
think	n.s.	n.s.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
hear	n.s.	n.s.	n.s.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
say	**	**	*	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
inform	***	***	***	**	n.s.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
announce	***	***	***	***	n.s.	n.s.	-	-	-	-	-	-	-	-	-	-	-	-	-
annoyed	***	***	***	***	***	*	n.s.	-	-	-	-	-	-	-	-	-	-	-	-
confess	***	***	***	***	***	*	n.s.	n.s.	-	-	-	-	-	-	-	-	-	-	-
reveal	***	***	***	***	***	**	*	n.s.	n.s.	-	-	-	-	-	-	-	-	-	-
acknowledge	***	***	***	***	***	***	**	n.s.	n.s.	n.s.	-	-	-	-	-	-	-	-	-
admit	***	***	***	***	***	***	**	n.s.	n.s.	n.s.	n.s.	-	-	-	-	-	-	-	-
establish	***	***	***	***	***	***	***	n.s.	n.s.	n.s.	n.s.	n.s.	-	-	-	-	-	-	-
demonstrate	***	***	***	***	***	***	***	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	-	-	-	-	-	-
discover	***	***	***	***	***	***	***	**	**	.	n.s.	n.s.	n.s.	n.s.	-	-	-	-	-
confirm	***	***	***	***	***	***	***	***	***	**	*	*	n.s.	n.s.	n.s.	-	-	-	-
see	***	***	***	***	***	***	***	***	***	**	**	*	n.s.	n.s.	n.s.	n.s.	-	-	-
know	***	***	***	***	***	***	***	***	***	***	***	***	**	*	n.s.	n.s.	n.s.	-	-
prove	***	***	***	***	***	***	***	***	***	***	***	***	***	***	**	.	.	n.s.	-
be right	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***

Table 1: P-values associated with pairwise comparison of contraditoriness ratings of prediates using Tukey's method. '***' indicates significance at .001, '**' at .01, '*' at .05, '.' marginal significance at .1, and 'n.s' indicates no significant difference in means.

Significant differences for restricted set:

- The five predicates that are typically taken to not entail the content of the complement ('no': *pretend, suggest, think, hear, say*) received significantly lower contradictoriness ratings than the seven predicates that are typically taken to entail the content of the complement (*annoyed, know, discover, reveal, see, establish, be right*). **except that now say is not different from annoyed**

- *inform (no?)* is still least veridical of the no?/yes predicates, next is *announce (no?)*: 'no' predicates *suggest* and *pretend* are less veridical than *inform* and *announce*, *think* and *hear* are only less veridical than *announce*

- The results suggest no differences in the veridicality of the verbs of communication, *say, inform* and *announce*.

- Highest veridicality, indistinguishable: *see, discover, prove (no?), confirm (no?), be right, know*, all have medians at ceiling

- *confess (no?), reveal (yes), admit (no?), acknowledge (no?), establish (yes), demonstrate (no?)* are indistinguishable the highest veridicality verbs except *know*, so probably also indistinguishable from *know*.

- *annoyed* is more veridical than *hear* and less veridical than *discover*, i.e., indistinguishable from *say, inform, announce, confess, reveal, admit acknowledge, establish, demonstrate, see*
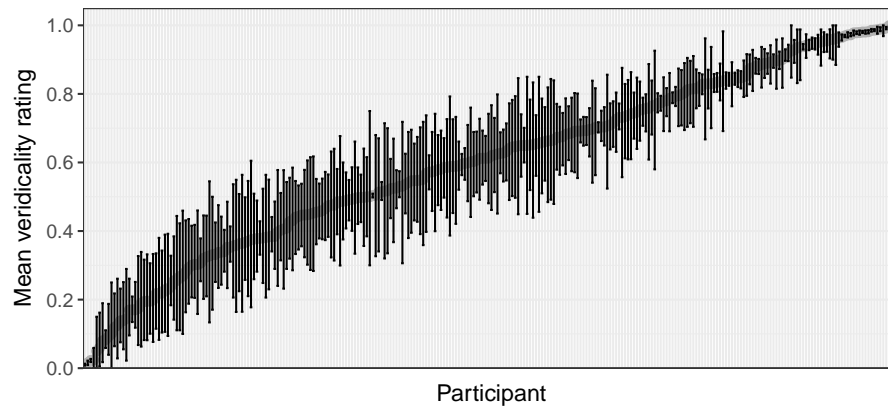
Figure 6: Boxplot of contradictoriness ratings by participant, collapsing across predicates and complement clauses. Grey dots indicate means and error bars indicate bootstrapped 95% confidence intervals.

3.3 Discussion

3.4 Interim summary

4 Projectivity

5 Discussion

6 Conclusions

A Materials used in the event probability norming study

The 20 event descriptions used in the event probability pretest; facts about the world that make the event more (H) or less likely (L) are given in parentheses.

1. Mary is pregnant (Mary is a middle school student / Mary is taking a prenatal yoga class)
2. Josie went on vacation to France (Josie doesn't have a passport / Josie loves France)
3. Emma studied on Saturday morning (Emma is in first grade / Emma is in law school)
4. Olivia sleeps until noon (Olivia has two small children / Olivia works the third shift)
5. Sophia got a tattoo (Sophia is a high end fashion model / Sophia is a hipster)
6. Mia drank 2 cocktails last night (Mia is a nun / Mia is a college student)
7. Isabella ate a steak on Sunday (Isabella is a vegetarian / Isabella is from Argentina)
8. Emily bought a car yesterday (Emily never has any money / Emily has been saving for a year)
9. Grace visited her sister (Grace hates her sister / Grace loves her sister)
10. Zoe calculated the tip (Zoe is 5 years old / Zoe is a math major)
11. Danny ate the last cupcake (Danny is a diabetic / Danny loves cake)
12. Frank got a cat (Frank is allergic to cats / Frank has always wanted a pet)
13. Jackson ran 10 miles (Jackson is obese / Jackson is training for a marathon)
14. Jayden rented a car (Jayden doesn't have a driver's license / Jayden's car is in the shop)

11

15. Tony had a drink last night (Tony has been sober for 20 years / Tony really likes to party with his friends)
16. Josh learned to ride a bike yesterday (Josh is a 75-year old man / Josh is a 5-year old boy)
17. Owen shoveled snow last winter (Owen lives in New Orleans / Owen lives in Chicago)
18. Julian dances salsa (Julian is German / Julian is Cuban)
19. Jon walks to work (Jon lives 10 miles away from work / Jon lives 2 blocks away from work)
20. Charley speaks Spanish (Charley lives in Korea / Charley lives in Mexico)

B Materials used in Exp 2

C Materials used in Exp 3

References

Abusch, Dorit. 2010. Presupposition triggering from alternatives. *Journal of Semantics* 27:37–80.

Anand, Pranav and Valentine Hacquard. 2014. Factivity, belief and discourse. In *The Art and Craft of Semantics: A Festschrift for Irene Heim*, pages 69–90. MIT Working Papers in Linguistics.

Chierchia, Gennaro and Sally McConnell-Ginet. 1990. *Meaning and Grammar*. Cambridge, MA: MIT Press.

Hothorn, Torsten, Frank Bretz, and Peter Westfall. 2008. Simultaneous inference in general parametric models. *Biometrical Journal* 50(3):346–363.

Karttunen, Lauri. 1971. Some observations on factivity. *Papers in Linguistics* 4:55–69.

R Core Team. 2016. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria.

Schlenker, Philippe. 2010. Local contexts and local meanings. *Philosophical Studies* 151:115–142.

Simons, Mandy. 2001. On the conversational basis of some presuppositions. In *Proceedings of Semantics and Linguistics Theory (SALT) XI*, pages 431–448. Ithaca, NY: CLC Publications.

Simons, Mandy, David Beaver, Craige Roberts, and Judith Tonhauser. 2017. The Best Question: Explaining the projection behavior of factive verbs. *Discourse Processes* 3.

Smith, E. Allyn and Kathleen Currie Hall. 2011. Projection diversity: Experimental evidence. In *Proceedings of the 2011 ESSLLI Workshop on Projective Content*, pages 156–170.

Tonhauser, Judith, David Beaver, and Judith Degen. ms. Variability in the information-structural status of projective content. Manuscript in preparation, The Ohio State University, University of Texas at Austin.

Xue, Jingyang and Edgar Onea. 2011. Correlation between projective meaning and at-issueness: An empirical study. In *Proceedings of the 2011 ESSLLI Workshop on Projective Content*, pages 171–184.