

## The influence of veridicality and event probability on projectivity

This paper explores the influence of two novel factors on the projectivity of the contents of clausal complements of 20 English clause-embedding predicates. Our experimental findings show that i) **veridicality** is a gradient property that does not distinguish clausal complements assumed to be entailed vs. non-entailed, ii) the content of clausal complements that are (assumed to be) entailed and non-entailed may be projective, iii) the projectivity of the content of the clausal complement is influenced by the **prior probability of the event** described by the clause, and iv) veridicality is not a predictor of projectivity. These findings raise important questions for the relationship between projectivity and entailment, and motivate analyses of projectivity according to which listeners integrate multiple sources of information, some conventional and some non-conventional, in determining what speakers are committed to (e.g., Abrusán 2011, 2016, Beaver et al. 2017).

### Presuppositions versus non-entailed projective content

The content of the clausal complement in (1a), that Julian dances salsa, is ‘projective’: a speaker who utters one of the variants in (1a) may be taken to be committed to this content even though the clause occurs in a polar question. The question of how this content comes to be projective is traditionally given very different answers for *discover* vs. *announce*. Whereas the content of the complement of *discover* is typically taken to be projective because it is a presupposition (e.g., Heim 1983, van der Sandt 1992), the content of the complement of *announce* is not analyzed as a presupposition because it is not entailed by the atomic sentence in (1b), in contrast to the content of the complement of *discover*. Thus, whereas *discover* is considered to be factive (i.e., it both entails and presupposes the content of its complement), *announce* is merely a “part-time trigger” (Schlenker 2010:139) that gives rise to the “illusion of factivity” (Anand and Hacquard 2014:76).

- (1) a. Did Sandy {discover / announce} that Julian dances salsa?
- b. Sandy {discovered / announced} that Julian dances salsa.

This paper addresses the question of whether it is empirically motivated to distinguish presuppositions and other projective inferences by whether the inference is an entailment of atomic sentences.

### Factors that influence the projectivity of projective content

The projectivity of (entailed) projective content is variable (e.g., Karttunen 1971, Kadmon 2001, Tonhauser et al. ms) and influenced by several conventional and non-conventional factors, incl. syntax (e.g., Potts 2005), context (e.g., Beaver 2010), prosody (e.g., Cummins and Rohde 2015, Tonhauser 2016) and at-issueness (e.g., Tonhauser et al. ms). We examined the influence of two novel factors on the projectivity of the content of the clausal complements: the prior probability of the event described by the clausal complement and the veridicality of the clause-embedding predicate. English-speaking participants were recruited on Amazon’s Mechanical Turk platform. Norming study #1 (n=95): We measured the prior probabilities of 20 events described by English clauses (e.g., *Julian dances salsa*) given one of two facts about the world for each event: one fact made the event more likely than the other fact (e.g., *Julian is Cuban* vs. *Julian is German*). The mean prior probability of the events was .7 when presented with facts that made the events more likely and .16 when presented with facts that make the events less likely. Assuming that less likely events are more likely to be at-issue, and that at-issue content does not project (Simons et al. 2010, Tonhauser et al. ms), prior event probability is predicted to influence projectivity.

Norming study #2 (n=300): Veridicality was defined as the extent to which sentences like (2) were judged to be contradictory; see, e.g., Chierchia and McConnell-Ginet’s 1990 diagnostic for entailment. Responses were given on a sliding scale from ‘definitely no’ to ‘definitely yes’.

(2) **Carol:** Sandra {discovered / announced / suggested} that Julian dances salsa, but he doesn't. The veridicality of 20 clause-embedding predicates was tested: 7 are typically taken to entail the complement (E: *be annoyed, know, discover, reveal, see, establish, be right*), 5 are typically taken to not entail the complement (NE: *pretend, think, suggest, say, hear*), and the remaining 8 are typically taken to not entail the content of the complement even though they may sometimes appear to (V: *prove, demonstrate, confess, inform, announce, acknowledge, admit, confirm*); see e.g., Schlenker 2010, Swanson 2012, Anand and Hacquard 2014. Each predicate was paired with the 20 event-describing clauses. As shown in Fig. 1, NE predicates are least veridical, as expected, but E predicates are not uniformly highly veridical and instead form a veridicality gradient with V predicates. Thus, contrary to standard assumptions, the diagnostic in (2) does not categorically distinguish entailed and non-entailed clausal complements.

### Experiment: Projectivity

This experiment explored the influence of prior probability and veridicality on the projectivity of the contents of clausal complements. Of the aforementioned 20 predicates, 6 are typically taken to be factive (*be annoyed, know, discover, reveal, see, hear*), 7 are typically taken to be non-factive (*be right, pretend, think, suggest, say, prove, demonstrate*), and the remaining 7 predicates have been suggested to be “part-time triggers” or to give rise to the “illusion of factivity” (*establish, confess, announce, acknowledge, admit, confirm, inform*); see references above.

Materials and procedure. 400 polar questions were formed from the 20 predicates and the 20 event-describing clauses. Participants were presented with 20 polar questions (one for each predicate), as shown in (3). Each polar question was presented with one of the two facts for the event described by clausal complement. Participants were asked to assess whether the speaker is certain of the content of the clausal complement (e.g., *Is Carol certain that Julian dances salsa?*) and gave their responses on a sliding scale from ‘no’ to ‘yes’.

(3) **Fact (which Carol knows):** Julian is German.

**Carol:** Did Sandra {discover / announce / suggest} that Julian dances salsa?

Results (n=300). Mean projectivity ratings are shown in Fig. 2. Replicating Tonhauser et al. ms, we observe variability in projectivity. Contents that describe more likely events were judged to be more projective than those that described less likely events ( $\beta = .34$ ,  $SE = .03$ ,  $t = 10.6$ ,  $p < .0001$ ), as revealed by a mixed effects linear regression predicting projectivity rating from fixed effects of mean prior probability (norming study #1), mean veridicality rating (norming study #2), and their interaction, as well as random effects for participant, verb, clausal complement, and fact. Neither veridicality nor its interaction with prior reached significance ( $p > .26$ ). This was true whether the analysis was conducted on the full dataset or only on projective contents (starting with *announce*).

### Discussion and theoretical implications

Although projectivity is influenced by the lexical meaning of clause-embedding predicates (e.g., Karttunen 1971, Tonhauser et al. ms), our findings do not support the assumption that entailment determines the empirical purview of analyses of projection. For instance, even though the veridicality of *reveal, be annoyed* and *confess* is statistically indistinguishable, the content of the complement of *be annoyed* is significantly more projective than that of *reveal* or *confess*. Our findings are compatible with analyses of projection that are not restricted to entailed content and according to which listeners integrate multiple sources of information, including prior event probabilities, in determining what speakers are committed to. Which lexical meaning properties of predicates influence projectivity and how these properties can be reliably diagnosed is a pressing question for future research.

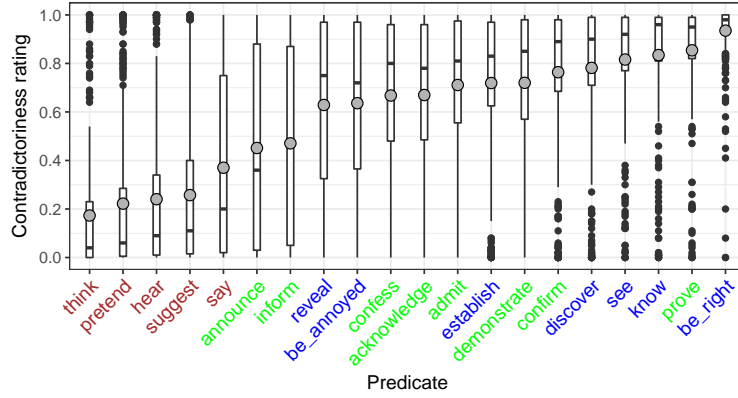


Figure 1: Boxplot of contradictoriness (veridicality) ratings by predicate, collapsing across complements. Grey dots indicate means and notches indicate medians. Colors code veridicality classes E (blue), NE (brown) and V (green).

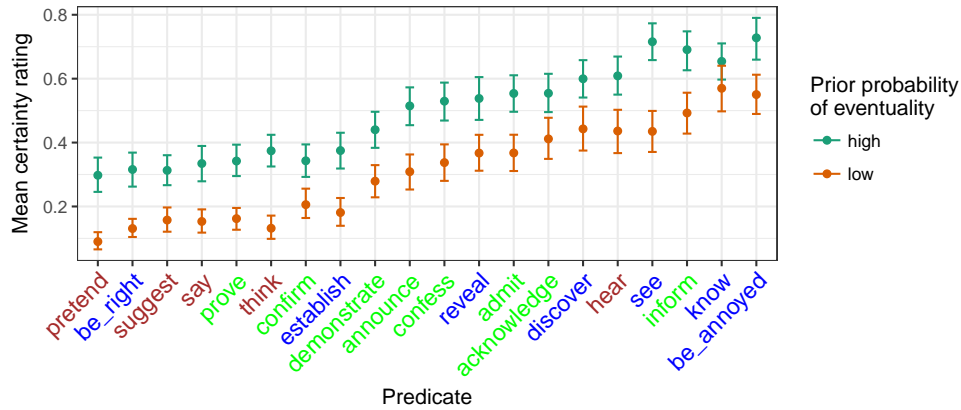


Figure 2: Mean certainty (projectivity) ratings by predicate and fact type, collapsing across complements. Error bars indicate 95% confidence intervals. Colors code veridicality classes E (blue), NE (brown) and V (green).

## References

- Abrusán, Márta. 2011. Predicting the presuppositions of soft triggers. *Linguistics & Philosophy* 34:491–535.
- Abrusán, Márta. 2016. Presupposition cancellation: Explaining the ‘soft-hard’ trigger distinction. *Natural Language Semantics* 24:165–202.
- 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.
- Beaver, David. 2010. Have you noticed that your belly button lint colour is related to the colour of your clothing? In R. Bäuerle, U. Reyle, and E. Zimmermann, eds., *Presuppositions and Discourse: Essays Offered to Hans Kamp*, pages 65–99. Oxford: Elsevier.
- Beaver, David, Craige Roberts, Mandy Simons, and Judith Tonhauser. 2017. Questions Under Discussion: Where information structure meets projective content. *Annual Review of Linguistics* 3.
- Chierchia, Gennaro and Sally McConnell-Ginet. 1990. *Meaning and Grammar*. Cambridge, MA: MIT Press.
- Cummins, Chris and Hannah Rohde. 2015. Evoking context with contrastive stress: Effects on pragmatic enrichment. *Frontiers in Psychology* 6:Article 1779.
- Heim, Irene. 1983. On the projection problem for presuppositions. In M. Barlow, D. Flickinger, and M. Westcoat, eds., *West Coast Conference on Formal Linguistics (WCCFL) 2*, pages 114–125.
- Kadmon, Nirit. 2001. *Formal Pragmatics*. Oxford: Blackwell.
- Karttunen, Lauri. 1971. Some observations on factivity. *Papers in Linguistics* 4:55–69.
- Potts, Christopher. 2005. *The Logic of Conventional Implicatures*. Oxford: OUP.
- Schlenker, Philippe. 2010. Local contexts and local meanings. *Philosophical Studies* 151:115–142.
- Simons, Mandy, Judith Tonhauser, David Beaver, and Craige Roberts. 2010. What projects and why. In *Semantics and Linguistic Theory (SALT) XXI*, pages 309–327. Ithaca, NY: CLC Publications.
- Swanson, Eric. 2012. Propositional attitudes. In *Semantics: An International Handbook of Natural Language Meaning*, vol. 2, pages 1538–1561. Berlin: Mouton de Gruyter.
- Tonhauser, Judith. 2016. Prosodic cues to speaker commitment. In *Semantics and Linguistic Theory (SALT) XXVI*, pages 934–960. Ithaca, NY: CLC Publications.
- Tonhauser, Judith, David Beaver, and Judith Degen. ms. How projective is projective content? Gradience in projectivity and at-issueness. Ms. under re-review. The Ohio State University, University of Texas at Austin, Stanford University.
- van der Sandt, Rob. 1992. Presupposition projection as anaphora resolution. *Journal of Semantics* 9:333–377.