Does at-issueness predict projection? It's complicated!

Taylor Mahler

The Ohio State University

1. Introduction

Projective content is content that a speaker can be taken to be committed to, despite that content being introduced by an expression that is in the syntactic scope of an entailment-cancelling operator (Chierchia & McConnell-Ginet 1990). The author of (1), for example, can be taken to be committed to the proposition that McAllister had gone very still, even though the clause introducing that proposition is embedded under an entailment-cancelling operator, in this case negation.

(1) For once, Dr. Neil, engrossed in drinking his coffee, did not notice that McAllister had gone very still. (British National Corpus)

One way to account for the behavior observed in examples like (1) is to attribute projection to the clause-embedding predicate itself, e.g., *notice* in (1): the content of the complement projects because the predicate specifies that the content of its complement is presupposed. The intuition of speaker commitment arises because presuppositions must be entailed by (Heim 1983) or satisfied in (van der Sandt 1992) the common ground.

Alternatively, projection might be related to other properties of utterance content. In their Gradient Projection Principle (GPP), Tonhauser et al. (2018) proposed that projection is related to *at-issueness*, i.e., the extent to which content addresses Roberts' (2012) Question Under Discussion (QUD):

(2) **Gradient projection principle (GPP):** If content C is expressed by a constituent embedded under an entailment-cancelling operator, then C projects to the extent that it is not-at-issue. (p. 499)

The GPP predicts a correlation between at-issueness and projection: content that is less at-issue should project to a greater extent than content that is more at-issue. For example,

in (1), the proposition *McAllister had gone very still* is predicted to project to the extent that it is not-at-issue.

To test the GPP's prediction that at-issueness and projection are correlated, Tonhauser et al. (2018) collected projection and at-issueness judgments for a number of projective contents (e.g., the contents of appositives, possessive NPs, complements of (semi-)factive predicates). The prediction was borne out: projection ratings were higher for content that was rated less at-issue than for content that was rated more at-issue.

The GPP also predicts that a particular content projects to a greater extent when it is less at-issue than when it is more at-issue. That is, a content should project more when uttered in a context in which it is less at-issue than when uttered in a context in which it is more at-issue. The current study tests this prediction by manipulating the at-issueness of projective contents, thereby addressing the research question in (3):

(3) **Research Question:**
Does a particular content project to a greater extent when it is less at-issue than when it is more at-issue?

The GPP crucially hinges on the assumption that projection is a gradient property of content, rather than a binary property. In other words, it is not the case that content either projects or fails to project, but rather that content can project to varying degrees. Since the current study tests a prediction of the GPP, I follow Tonhauser et al. (2018) in assuming that projection is a gradient property of content.

Investigating the research question in (3) requires a way of both manipulating and diagnosing at-issueness. Section 2 provides background about at-issueness, including assumptions about how at-issueness is manipulated (section 2.1) and diagnosed (section 2.2). In section 3, I discuss the extent to which prior experimental implementations of these manipulations and diagnostics provide preliminary evidence for the GPP. Section 4 presents the experiment, and section 5 concludes.

2. At-issueness

The notion of at-issueness invoked by the GPP is defined in terms of relevance to Roberts' (2012) Question Under Discussion (QUD):

(4) Definition of at-issueness (Simons et al. 2010, p. 323)
   a. A proposition *p* is at-issue iff the speaker intends to address the QUD via ?*p*.
   b. An intention to address the QUD via ?*p* is felicitous only if:
      (i) ?*p* is relevant to the QUD, and
      (ii) the speaker can reasonably expect the addressee to recognize this intention.

To understand how this definition is used to determine which content is at-issue, consider example (5).

(5) **Person 1:** What about Don? Is he American?
Person 2: Perhaps Rachel discovered that he's Canadian.

Assume that the QUD is *Is Don American?*, and that we would like to determine whether the clausal complement content in Person 2's utterance, i.e., *Don is Canadian*, is at-issue. To do so, we must determine whether this content addresses the QUD. According to Simons et al. (2010), content addresses (i.e., is relevant to) a question iff it contextually entails a (partial or complete) answer to that question, where contextual entailment is defined following Roberts (2012):

(6) Contextual entailment (Roberts 2012, p. 12):

> A question *q1* contextually entails another *q2* iff answering *q1* in a discourse context with common ground *C* (a set of propositions) is such that $C \cup \text{Ans}(q1)$ entails a complete answer to *q2*.

Contextual entailment is understood within an analysis of questions as sets of propositional alternatives. A complete answer is "a proposition which contextually entails an evaluation for each element of q-alt (*q*)", where q-alt is the set of alternatives corresponding to the question (p. 11).[1]

To calculate the at-issueness for the content of interest, the QUD must be represented as a set of alternative propositions constituting possible answers to that question. For the QUD *Is Don American?* the set is {*Don is American, Don is not American*} - this question corresponds to *q2* in the definition in (6). Since contextual entailment is defined as a relation between questions, the content of interest must also be represented as a set of alternative propositions, namely, those that correspond to the polar question associated with that proposition. For the proposition *Don is Canadian*, the set of alternatives is *Don is Canadian, Don is not Canadian* — this question corresponds to *q1* in the definition in (6).

q1 {*Don is Canadian, Don is not Canadian*} contextually entails *q2* {*Don is American, Don is not American*} iff the union of the common ground propositions and the possible answers to *q1* entail a complete answer, i.e., an evaluation of each alternative in *q2*. Assume that one of the propositions in the common ground is that people typically have one nationality. Then if *Don is Canadian* is true, it must be the case that *Don is American* is false and *Don is not American* is true. That is, all of the alternatives in *q2* must be evaluated. Hence, *q1* contextually entails a complete answer to *q2*, and is at-issue content.

On this definition of at-issueness, whether a content is at-issue crucially depends on which QUD is in the discourse. A proposition may contextually entail an answer to one QUD and hence be at-issue, and fail to contextually entail an answer to another QUD and hence be not-at-issue. Manipulating at-issueness, then, requires that content be interpreted with respect to QUDs that differ according to whether they are addressed by that content.

[1] Roberts (2012) also defines partial answerhood: a "*partial answer* to a question *q* is a proposition which contextually entails the evaluation – either true or false – of at least one element of q-alt (*q*). As partial answerhood is not relevant for the analysis of the stimuli used in this study, it will not be discussed further.

2.1 Manipulating at-issueness

Given that manipulating the at-issueness of content requires that the content be interpreted with respect to different QUDs, how should these QUDs be constructed? One possibility is to vary the prosodic realization of the utterances that convey the projective contents. The experimental literature suggests that speakers use prosody to indicate which question an utterance addresses (e.g., Birch & Clifton 1995, Breen et al. 2010). Hence, when the prosody of an utterance indicates that the utterance is intended to address a question that is also addressed by the content of interest, this content should be at-issue. When the prosody indicates a different question, one that is not addressed by this same content, that content should be not-at-issue.

But prosody is not the only way to raise a QUD. Speakers can also use interrogative utterances to raise QUDs. Hence, interrogative utterances should influence at-issueness (e.g., Amaral et al. 2007). On this assumption, content is at-issue in the context of an interrogative utterance that it addresses, and not-at-issue in the context of an interrogative utterance that it does not address. Consider the proposition *Don is Canadian* in (7):

(7) a. **Person 1:** What about Don? Is he American?
Person 2: Perhaps Rachel discovered that he's Canadian.

b. **Person 1:** What about Rachel? Why did she bring maple syrup?
Person 2: Perhaps she discovered that Don's Canadian.

(7a) is identical to (5). As shown in the preceding section for (5), the content *Don is Canadian* is at-issue in (7a). That is, this content contextually entails an evaluation of all the alternatives associated with the polar question *Is Don American?*, assuming a common ground that includes the proposition that humans typically have exactly one nationality.

In (7b), however, the content *Don is Canadian* is not-at-issue. The alternative set corresponding to Person 2's second utterance in (7b) is $\{$Rachel brought maple syrup because $z\}$, where z ranges over the propositions that give a reason that Rachel brought maple syrup. *Don is Canadian* does not contextually entail an evaluation of any of the alternatives in this set. That is, unless Rachel has some particular relation to this proposition, e.g., by believing, knowing, or thinking it to be true, Don's being or not being Canadian does not explain why she would bring maple syrup. One relation which Rachel might have to that proposition is expressed in the main clause: the relation *discover*. So while the main clause content is at-issue with respect to Person 1's second interrogative utterance, the complement clause content is not-at-issue, because it is not of the right form to provide an explanation for why Rachel brought maple syrup and so does not contextually entail an answer to this question.

In the current study, at-issueness is manipulated with interrogative utterances, presented as text (as opposed to being presented auditorily). This choice is motivated by two considerations. First, prior experimental work has already investigated the effect of prosody on projection (Cummins & Rohde 2015, Tonhauser 2016, Djärv & Bacovcin 2017), but no prior work has explored the effect of different interrogative utterances on projection. Second, while interrogative utterances have been used in experimental work to manipulate the

QUD (e.g., Rohde et al. 2007, Zondervan et al. 2008), the assumption that interrogative utterances influence at-issueness has not been experimentally validated. Using interrogative utterances to manipulate at-issueness therefore broadens our understanding of both projection and at-issueness.

2.2 Diagnosing At-issueness

Verifying the assumption that interrogative utterances influence at-issueness requires a way of diagnosing at-issueness. The at-issueness diagnostics that have been proposed in the literature differ in the assumptions they rely upon and the properties of at-issue content they are intended to exploit.

Tonhauser's (2012) direct dissent diagnostic and its variations operationalize the assumption that at-issue content is more readily dissented with than not-at-issue content. In the illustration of the direct dissent diagnostic in (8), B1 felicitously dissents with the main clause content, suggesting that this content is at-issue. The infelicity of B2's attempt to dissent with the appositive content would then be taken to indicate that the appositive content is not-at-issue.

(8) A: Anne, who is a teacher, lives in Denmark.
B1: No, she doesn't live in Denmark.
B2: #No, she's not a teacher.

The assumption that at-issue content is more readily dissented with than not-at-issue content has also been implemented in diagnostics that prompt participants to choose between either directly or indirectly dissenting/assenting with content (e.g., Xue & Onea 2011, Syrett & Koev 2015, Destruel et al. 2015). Selecting a direct dissent/assent utterance is taken to indicate that the content is at-issue, whereas selecting an indirect dissent/assent utterance is taken to indicate that the content is not-at-issue.

The variation of the direct dissent diagnostic illustrated in (8) was selected for the current study. This diagnostic was selected because the assumption underlying it – that at-issue content is more readily dissented with than not-at-issue content – has been widely implemented in at-issueness diagnostics (in addition to the studies cited above, Tonhauser et al.'s (2018) *Are you sure?* diagnostic relies on this assumption). The current study is the first to both manipulate and measure at-issueness in the same experiment. It is also the first experiment in which interrogative utterances are used to manipulate at-issueness, rather than prosody. Given these novel aspects of the experimental design, a diagnostic resting on a well-tested assumption is preferable to diagnostics that have been less widely implemented in experimental settings.

The direct dissent diagnostic has two further properties that distinguish it from other diagnostics. First, several other at-issueness diagnostics diagnose the at-issueness of contents expressed exclusively by interrogative utterances (see e.g., other diagnostics proposed by Tonhauser 2012 as well as Tonhauser et al.'s (2018) *Asking whether?* diagnostic). On the other hand, the direct dissent diagnostic diagnoses the at-issueness of contents expressed by declarative utterances, the utterance type explored in the current study. The direct dissent

diagnostic also differs from other at-issueness diagnostics in that it allows for gradience in at-issueness judgments. Some other diagnostics are binary in nature, involving a selection between two ways of assenting/dissenting with content (e.g., those implemented by Xue & Onea 2011, Syrett & Koev 2015, Destruel et al. 2015). In contrast, the direct dissent diagnostic probes acceptability judgments. Since acceptability judgments can be gradient, the direct dissent diagnostic can capture gradient judgments of at-issueness, consistent with the GPP's characterization of at-issueness.

3. Preliminary Evidence for the GPP

Experimental work on projection that manipulate and/or diagnose at-issueness provides preliminary evidence for the GPP. Several of these studies have already been mentioned to illustrate the various at-issueness diagnostics and manipulations. Here I discuss these studies as they relate to the predictions of the GPP.

The GPP predicts that projectivity and at-issueness are correlated: a content that is less at-issue is also more projective, and a different content that is more at-issue is less projective. Consistent with this prediction, Tonhauser et al. (2018) found evidence for such a correlation in a set of experiments designed to probe at-issueness and projectivity judgments (see also Xue & Onea 2011 for a similar finding).

The current study tests the GPP's prediction that a particular content projects to a greater extent when it is less at-issue than when it is more at-issue. As discussed in section 1, testing this prediction requires manipulating at-issueness. In research on projection, the only way in which at-issueness has been manipulated is by varying the prosodic realization of utterances. Cummins & Rohde (2015) found that participants rated content as less projective when the content was prosodically focused than when it was not. Tonhauser (2016) replicated this effect for the complements of (semi-)factive predicates (see also Djärv & Bacovcin 2017). However, these experiments do not measure the influence of prosody on at-issueness using an at-issueness diagnostic.

Taken together, these findings provide preliminary evidence for the GPP. The correlation between projection and at-issueness confirms the GPP's prediction that less at-issue content is more projective and more at-issue content is less projective. The finding that content projects less when it is prosodically focused than when it is not prosodically focused is consistent with, but does not directly support, the GPP's prediction that at-issueness influences projection. This latter finding can only be interpreted as evidence for the GPP in conjunction with the assumption that prosody manipulates at-issueness. Given that this assumption has not been experimentally validated by both manipulating and measuring at-issueness, it remains an open question whether it is at-issueness (and not e.g., a property specific to prosodic focus) that influences projection. In other words, the prosody studies provide only indirect support for the GPP.

Given the lack of direct support for the GPP's prediction that content projects more when it is less at-issue than when it is more at-issue, I conducted an experiment to test this prediction directly. The experiment employs an at-issueness manipulation that has not been previously used in an experimental setting: interrogative utterances. Crucially, I also test the assumption that interrogative utterances manipulate at-issueness by measuring at-issueness

with respect to the experimental manipulation. The GPP's prediction will be borne out if particular contents are less at-issue and more projective when they do not address an interrogative utterance than when they do address an interrogative utterance.

4. Experiment

The experiment was designed to answer the research question in (3), repeated here as (9) for convenience:

(9) **Research Question:**
Does a particular content project to a greater extent when it is less at-issue than when it is more at-issue?

The projective contents explored in the experiment were the contents expressed by the complements of (semi-)factive predicates. Each content was paired with two interrogative utterances that were hypothesized to have different effects on the at-issueness of the content. Participants rated the projectivity and at-issueness of the projective contents in two separate experimental blocks.

Projectivity was measured using the 'certainty' diagnostic used by e.g., Tonhauser (2016), Stevens et al. (2017) and Tonhauser et al. (2018). This diagnostic assesses speaker commitment by asking participants to indicate the extent to which the speaker is certain of the projective content. At-issueness was measured using the direct dissent diagnostic, discussed in detail in section 2.2.

4.1 Participants

100 participants were recruited on Amazon's Mechanical Turk platform and paid $1.00 for participating in the experiment. Participants had US IP addresses and at least 97% of previous HITs approved. These 100 participants ranged in age from 18-65 years (median: 34 years). Data from 12 participants who did not self-report being native speakers of American English was excluded. As will be discussed in section 4.4, data from an additional 15 participants was excluded on the basis of incorrect responses to the control items. The remaining 73 participants ranged in age from 18-65 (median: 34 years).

4.2 Materials

The projective contents explored in the experiment were the contents expressed by the complements of 5 (semi-)factive predicates: *discover, realize, know, be aware*, and *notice*. Three target sentences were constructed for each predicate, for a total of 15 target sentences. These target sentences were adapted from Tonhauser (2016) and consisted of a subject, the predicate, and a clausal complement, all embedded under the entailment-cancelling operator *perhaps*, as in (10):

(10) Perhaps Rachel discovered that Don's Canadian.

The projective content explored in (10) is the content expressed by the complement of *discover*, that Don is Canadian.

Each target sentence was presented in the context of two types of interrogative utterance sequences, as in (11a) and (11b). The interrogative utterance contexts were presented as being spoken by a speaker referred to as Person 1, and target sentences were presented as the utterances of a speaker referred to as Person 2.[2]

(11) Example projection block stimuli

a. Polar Question Context
Person 1: What about Don? Is he American?
Person 2: Perhaps Rachel discovered that he's Canadian.

b. *Why*-Question Context
Person 1: What about Rachel? Why did she bring maple syrup?
Person 2: Perhaps she discovered that Don's Canadian.

The interrogative utterance sequences consisted of a *what*-question about one of the two people mentioned in the target sentence, followed by either a polar question in the Polar Question context (11a) or a *why*-question in the *Why*-Question context (11b). The content of the complement (e.g., that Don is Canadian) was hypothesized to be at-issue in the Polar Question Context, and not-at-issue in the *Why*-Question context. These hypotheses are motivated in section 2.1 on the basis of Simons et al.'s (2010) definition of at-issueness.

Combining each target sentence with the two interrogative utterance conditions yielded 30 target stimuli. These 30 stimuli were used in the projection block of the experiment.

An additional 30 target stimuli were created for the at-issueness block by combining the two turns from the projection block stimuli with a third turn by a third speaker, Person 3. In the third turn, Person 3 dissented with the content of the complement in the target sentence, as in (12a) and (12b):

(12) Example at-issueness block stimuli

a. Polar Question Context
Person 1: What about Don? Is he American?
Person 2: Perhaps Rachel discovered that he's Canadian.
Person 3: No, he's not Canadian.

b. *Why*-Question Context
Person 1: What about Rachel? Why did she bring maple syrup?
Person 2: Perhaps she discovered that Don's Canadian.
Person 3: No, he's not Canadian.

[2]Names for the speakers were not used for two reasons: (i) given that there were already different names within each item, using a different set of 3 speaker names for each stimulus may have confused or overwhelmed participants, (ii) using the same set of 3 speaker names throughout the experiment may have caused participants to associate particular characteristics (e.g., certainty) with particular speakers early in the experiment, thereby influencing judgments of projectivity and/or at-issueness for items later in the experiment.

In total, there were 60 target stimuli, 30 for the projection block, and 30 for the at-issueness block. These 60 stimuli were distributed across two lists. List 1 included 15 projection block stimuli, 8 in the Polar Question Context and 7 in the *Why*-Question Context. The 15 at-issueness block stimuli whose target sentences appeared in these same interrogative utterance contexts were also added to List 1. List 2 included the other 15 projection block stimuli, 7 in the Polar Question Context and 8 in the *Why*-Question Context, as well as the other 15 at-issueness block stimuli whose target sentences appeared in the same interrogative utterance contexts in the projection block.

In order to assess whether participants were paying attention, two control stimuli were also created for each block. In the projection block, the control stimuli consisted of two-turn dialogues, as in (13) and (14).

(13) Control Stimulus 1

Person 1: What about Ronald? Was he feeling well?
Person 2: He was tired.

(14) Control Stimulus 2

Person 1: What about Leah? Was she there?
Person 2: She was invited to the party.

The two control stimuli for the at-issueness block were created by combining the two turns from the projection block controls with a third turn. In the third turn, a third speaker dissented with a content in the second speaker's utterance, as shown in in (15) and (16).

(15) Control Stimulus 3

Person 1: What about Ronald? Was he feeling well?
Person 2: He was tired.
Person 3: No, he wasn't tired.

(16) Control Stimulus 4

Person 1: What about Leah? Was she there?
Person 2: She was invited to the party.
Person 3: No, she wasn't invited.

The content of interest in the control stimuli was the content expressed by Person 2's utterance, i.e., *Ronald was tired* and *Leah was invited to the party*. These contents are expressed by main clauses and they are not embedded under entailment-cancelling operators. They were therefore expected to be commitments of the speaker and highly at-issue.

The two at-issueness block controls and the two projection block controls were added to both lists, for a total of 17 projection block stimuli and 17 at-issueness block stimuli per list. The full set of stimuli can be found in the appendix.

4.3 Procedure

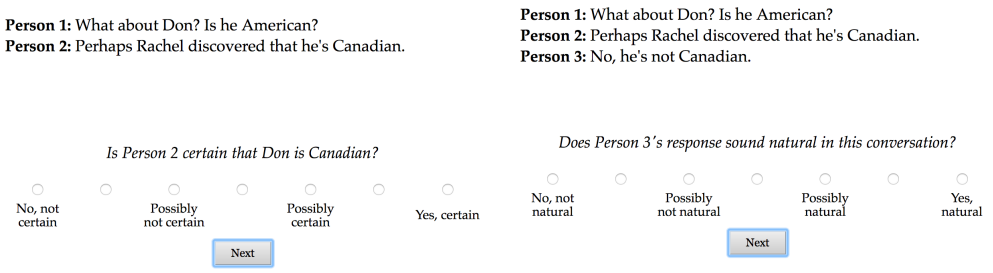
The participants were randomly assigned to one of the two lists. Each participant saw the 17 projection stimuli on their list in the projection block of the experiment, and the 17 at-issueness stimuli on their list in the at-issueness block. Block order and within-block trial order were randomized.

Participants were told to imagine that they are at a party and that they overhear some people talking as they walk into the kitchen. On each trial, participants read the stimulus dialogue followed by a response question. In the projection block, the response question for the target stimuli was about the speaker's certainty with respect to the content of the complement clause in the target sentence, as shown in the left panel of the figure in (17). The response question for the control stimuli was about the main clause content (*Is Person 2 certain that Ronald was tired?, Is Person 2 certain that Leah was invited to the party?*). Participants gave their response on a 7-point Likert scale labeled at 4 points: No, not certain/1, Possibly not certain/3, Possibly certain/5, Yes, certain/7. The higher the response, the more projective the clausal complement content was taken to be.

In the at-issueness block, the response question for the target and control stimuli was about the naturalness of Person 3's utterance, as shown in the right panel of the figure in (17). Participants gave their response on a 7-point Likert scale labeled at 4 points: No, not natural/1, Possibly not natural/3, Possibly natural/5, Yes, natural/7. The higher the response, the more at-issue the clausal complement content was taken to be.

At the end of the experiment, participants completed a questionnaire about their age and native languages.

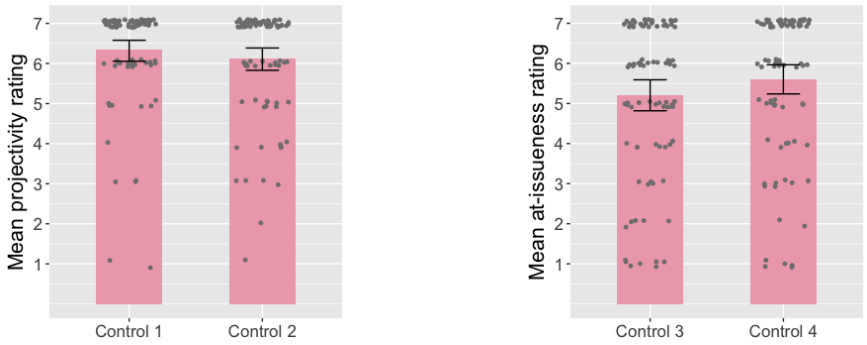
(17) *Sample trials in the projection block (left) and at-issueness block (right)*



4.4 Data exclusion and responses to control stimuli

The figure in (18) shows the mean responses for the projection block controls (left panel) and at-issueness block controls (right panel). The participants' raw responses are shown as grey dots, jittered within each rating category to show the density of responses at each point on the rating scale. Responses to the control stimuli in both the at-issueness and projection blocks were expected to be high.

(18) *Mean responses to control items in projection block (left) and at-issueness block (right) with 95% confidence intervals. Participants raw responses are shown as grey dots.*



As expected, the responses to the projection block controls received high ratings, with responses clustered toward the top of the scale (Control 1: mean = 6.34, SD = 1.24; Control 2: mean = 6.11, SD = 1.36). The responses to the at-issueness block controls were lower than the responses to the projection block controls, with many responses in the mid-to-low range of the scale (Control 3: mean = 5.22, SD = 1.9; Control 4: mean = 5.60, SD=1.74). Given the lower-than-expected ratings for the at-issueness block controls, these were not used to exclude participant data.

The projection block controls were used to exclude participant data. Data was excluded from participants whose response to one or more projection block controls was below 5. Five was used as the cutoff point since this rating corresponds to the highest point on the scale that indicates speaker certainty (labeled "Possibly certain"). Given that the contents of interest in the control items were expressed by main clauses and not embedded under an entailment cancelling operator, responses indicating speaker uncertainty are highly unexpected and suggest that participants were not attending to the task or did not understand it.

4.5 Results

This study was designed to test the GPP's prediction that a content projects more when it is less at-issue than when it is more at-issue. I begin by discussing in section 4.5.1 whether the at-issueness manipulation – interrogative utterances – influenced projection. In section 4.5.2, I discuss whether the interrogative utterances did in fact manipulate at-issueness, as assessed by the direct dissent diagnostic.

4.5.1 Predicting projectivity ratings from interrogative utterance context

Mean projectivity ratings (with 95% confidence intervals) for the target stimuli in the two interrogative utterance conditions are shown in the left panel of the figure in (19). Participants' response means are shown as grey dots.

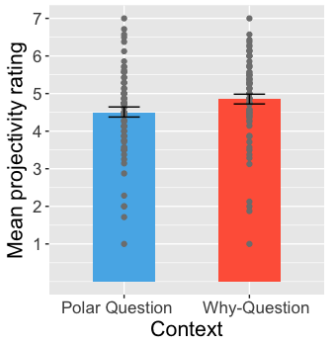
As expected, stimuli in the *Why*-Question Context received higher ratings (mean = 4.85) than in the Polar Question Context (mean = 4.50). This qualitative observation about the relation between interrogative utterances and projectivity was confirmed statistically by an ordinal mixed-effects regression model predicting projectivity from fixed effects of question type, block order, and their interaction, using as the reference levels the Polar Question Context and the block order in which the projection block was presented first. The maximal random effects structure for which the model converged included random intercepts for participants and target sentences, as well as random context slopes for participants, random context and block order slopes for target sentences, and random slopes for the interaction between context and block order for target sentences. Log-likelihood comparisons between the full model and models without each of the fixed effects revealed a significant effect of context ($\beta = 0.65, SE = 0.18, z = 3.65, \chi^2(1) = 14.05, p < 0.001$). The block order effect did not reach significance ($\beta = -0.52, SE = 0.45, z = -1.15, \chi^2(1) = 2.42, p = .12$), nor did the interaction term ($\beta = -0.22, SE = 0.25, z = -0.88, \chi^2(1) = .77, p = .38$).

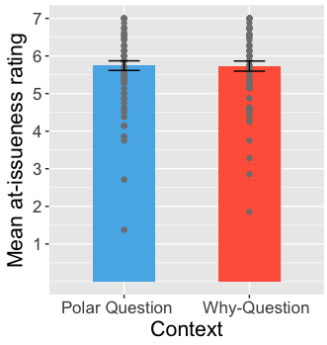
4.5.2 Predicting at-issueness ratings from interrogative utterance context

Mean at-issueness ratings (with 95% confidence intervals) for the target stimuli in the two interrogative utterance conditions are shown in the right panel of the figure in (19). Participants' response means are again shown as grey dots.

Contrary to expectation, the mean ratings in the two conditions were not different from each other (both means = 5.74). This observation was also confirmed statistically. The data were fit to an ordinal mixed effects regression model predicting responses in the at-issueness block from fixed effects of context, block order, and their interaction, using the same reference levels as in the previous analysis. The maximal random effects structure for which the model converged included intercepts for target sentences and participants, block order and context slopes for target sentences, and context slopes for participants. Log-likelihood comparisons of the full model to models without each of the fixed effects revealed that none of the fixed effects were significant. As suggested by the right panel of the figure in (19), there was no effect of context ($\beta = -2.90, SE = 0.22, z = -1.32, \chi^2(1) = .47, p = 0.49$). Neither was there a significant effect of block order ($\beta = -0.07, SE = 0.55, z = -0.13, \chi^2(1) = 0.17, p = 0.68$), or of the interaction between block order and context ($\beta = 0.38, SE = 0.31, z = 1.25, \chi^2(1) = 1.53, p = 0.22$).

(19) *Mean projectivity ratings for each context (left) and mean at-issueness ratings for each context (right) with 95% confidence intervals. Participant means are shown as grey dots.*





4.6 Discussion

This experiment was designed to test the GPP's prediction that content projects more when it is less at-issue than when it is more at-issue. To test this prediction, projective contents were presented in the context of an interrogative utterance hypothesized to make the content not-at-issue (the *Why*-Question Context), and in the context of an interrogative utterance hypothesized to make the content at-issue (the Polar Question Context). As expected, content was found to be more projective in the *Why*-Question Context than in the Polar Question Context. Together with the assumption that interrogative utterances influence at-issueness, this finding is consistent with the GPP's prediction that content projects more when it is less at-issue than when it is more at-issue.

In order to test the assumption that the interrogative utterances manipulated at-issueness, the direct dissent diagnostic was used to measure the at-issueness of the projective contents in the two interrogative utterance contexts. Content was expected to receive higher ratings in the Polar Question Context than in the *Why*-Question Context. Contrary to expectation, there was no effect of interrogative utterance context on responses to the direct dissent diagnostic. The experimental results do not then provide evidence that interrogative utterances manipulate at-issueness, but they also cannot be interpreted as providing evidence against this assumption.

To the extent that absence of an interrogative utterance effect on responses to the direct dissent diagnostic is an artifact of the experimental design, the finding that content was more projective in the *Why*-Question Context than in the Polar Question Context provides support for the GPP. Given that no prior experimental work both manipulates and measures at-issueness, it is not yet clear how at-issueness manipulations and diagnostics interact. The direct dissent diagnostic is a standard diagnostic for at-issueness, but it has only been used to assess the at-issueness of contents expressed within isolated utterances. In the current study, participants assessed the at-issueness of content with respect to an explicit context rather than in isolation. Whether existing diagnostics are suitable for diagnosing at-issueness in experimental designs that involve contextual at-issueness manipulations is a pressing task for future research on at-issueness.

It is also possible that the direct dissent diagnostic does not diagnose at-issueness at all, or at least not the question-based notion of at-issueness assumed here. The assumption underlying this diagnostic is that at-issue content is more readily dissented with than not-at-

issue content. Given that content can only be dissented with if it is available for anaphoric reference, Snider (2017) argued that the direct dissent diagnostic diagnoses anaphoric availability rather than at-issueness. He further provided evidence showing that anaphoric availability is neither necessary nor sufficient for content to be at-issue. Since interrogative utterances are not expected to influence anaphoric availability, Snider's (2017) evaluation of the direct dissent diagnostic could account for the unexpected absence of an interrogative utterance effect on responses to the diagnostic.

At the very least, different at-issueness diagnostics might measure different underlying notions of at-issueness, possibly related to the varying assumptions on which they rely. Preliminary evidence that the diagnostics differ in this way comes from Tonhauser et al. (2018), who found that at-issueness ratings obtained using different at-issueness diagnostics were not perfectly correlated. The direct dissent diagnostic is closely tied to definitions of at-issueness in terms of how content updates the common ground (e.g., Murray 2014, AnderBois et al. 2013). It may be that the direct dissent diagnostic diagnoses at-issueness as defined in this way, but that other diagnostics (e.g., diagnostics relying on the assumptions that at-issue content addresses the QUD and determines the set of alternatives) diagnose at-issueness as defined in terms of the QUD. The next step in understanding the influence of at-issueness on other properties of content – including projection – is to determine whether and how varying definitions of at-issueness are related to the assumptions underlying at-issueness diagnostics and manipulations.

5. Conclusion

Prior experimental work has shown that at-issueness is correlated with projectivity and that prosody influences projection, providing preliminary support for the GPP. In this research, I tested the GPP's prediction that content projects more when it is less at-issue than when it is more at-issue. The results are consistent with this prediction, showing that content projects more when it does not address an interrogative utterance than when it does. However, interrogative utterances were not found to influence responses to the direct dissent diagnostic for at-issueness. Due to the absence of an interrogative utterance effect on responses to the diagnostic, the results do not provide evidence that at-issueness is implicated in projectivity. They also, though, do not speak against the role of at-issueness in projectivity, and are therefore consistent with the GPP.

As the first experiment to attempt an at-issueness manipulation, one of the main contributions of this study is to demonstrate the complexity and challenge of manipulating and diagnosing at-issueness in tandem. While interrogative utterances are standardly assumed to influence at-issueness, it is not clear that even a widely-used diagnostic – the direct dissent diagnostic – is suitable for measuring the effects of this manipulation. Determining which (if any) existing at-issueness diagnostics are suitable for this purpose will be crucial for testing hypotheses in which at-issueness is invoked as an explanatory factor, including the GPP.

Appendix: Stimuli

The materials used in both the projection and at-issueness blocks are grouped below by target sentence they appeared with. The labels in the left column indicate the first letter of the predicate used in target sentence (e.g., D for *discover* in D1) and are appended with a number 1-3 for each of the three target sentences that used that predicate. The first line shows the interrogative utterances used in the Polar Question Context and the second line shows the interrogative utterances used in the *Why*-Question Context. The target sentence is in italics in the third line; for words separated by a slash, the word to the left of the slash was used in the Polar Question Context and the word to the right of the slash was used in the *Why*-Question Context. The direct dissent utterance, used only in the at-issueness block, is shown in the fourth line in parentheses.

D1
What about Lisa? Is she married?
What about Josh? Why did he smile?
Perhaps Josh/he discovered that she's/Lisa's a widow.
(No, she's not a widow.)

D2
What about John? Is he a bachelor?
What about Alice? Why was she upset?
Perhaps Alice/she discovered that he's/John's a father.
(No, he's not a father.)

D3
What about Don? Is he American?
What about Rachel? Why did she bring maple syrup?
Perhaps Rachel/she discovered that hes/Don's Canadian.
(No, he's not Canadian.)

R1
What about Mary? Is she poor?
What about Bob? Why did he refuse to pay?
Perhaps Bob/he realized that she's/Mary's wealthy.
(No, she's not wealthy.)

R2
What about Cory? Was he healthy?
What about Sarah? Why was she concerned?
Perhaps Sarah/she realized that he/Cory had a virus.
(No, he didn't have a virus.)

R3
What about Megan? Was she faithful?
What about Evan? Why was he angry?
Perhaps Evan/he realized that she/Megan was cheating on him.
(No, she wasn't cheating on him.)

K1 What about Andy? Was he innocent?
What about Linda? Why was she worried?
Perhaps Linda/she knew that he/Andy was a criminal.
(No, he's not a criminal.)

K2 What about Cindy? Was she single?
What about Daniel? Why was he disappointed?
Perhaps Daniel/he knew that she/Cindy was married.
(No, she wasn't married.)

K3 What about Bill? Was he correct?
What about Rhonda? Why was she irritated?
Perhaps Rhonda/she knew that he/Bill was wrong.
(No, he wasn't wrong.)

A1 What about William? Does he eat meat?
What about Martha? Why did she serve tofu?
Perhaps Martha/she was aware that he's/Williams a vegetarian.
(No, he's not a vegetarian.)

A2 What about Simon? Is he dependable?
What about Erin? Why did she do it herself?
Perhaps Erin/she was aware that he's/Simons unreliable.
(No, he isn't unreliable.)

A3 What about Robert? Did he have a good reputation?
What about Chelsea? Why did she reject his application?
Perhaps Chelsea/she was aware that he/Robert had bad reviews.
(No, he didn't have bad reviews.)

N1 What about Lily? Did she have everything?
What about Ryan? Why did he sigh?
Perhaps Ryan/he noticed that she/Lily was missing something.
(No, she wasn't missing anything.)

N2 What about David? Did he have good oral hygiene?
What about Jessica? Why did she walk away?
Perhaps Jessica/she noticed that he/David had bad breath.
(No, he didn't have bad breath.)

N3 What about Gina? Was she full from lunch?
What about Steven? Why did he bring sandwiches?
Perhaps Steven/he noticed that she/Gina was hungry.
(No, she wasn't hungry.)

Control1 What about Ronald? Was he feeling well?
He was tired.
(No, he wasn't tired.)

Control2 What about Leah? Was she there?
She was invited to the party.
(No, she wasn't invited.)

References

Amaral, Patricia, Craige Roberts, & E. Allyn Smith. 2007. Review of the logic of conventional implicatures by Chris Potts. *Linguistics and Philosophy* 30:707–749.

AnderBois, Scott, Adrian Brasoveanu, & Robert Henderson. 2013. At-issue proposals and appositive impositions in discourse. *Journal of Semantics* 32:93–138.

Birch, Stacy, & Charles Clifton. 1995. Focus, accent, and argument structure: Effects on language comprehension. *Language and Speech* 38:365–391.

Breen, Mara, Evelina Fedorenko, Michael Wagner, & Edward Gibson. 2010. Acoustic correlates of information structure. *Language and Cognitive Processes* 25:1044–1098.

Chierchia, Gennaro, & Sally McConnell-Ginet. 1990. *An Introduction to Semantics*. Cambridge: MIT Press.

Cummins, Chris, & Hannah Rohde. 2015. Evoking context with contrastive stress: Effects on pragmatic enrichment. *Frontiers in Psychology* 6.

Destruel, Emilie, Daniel Velleman, Edgar Onea, Dylan Bumford, Jingyang Xue, & David Beaver. 2015. A cross-linguistic study of the non-at-issueness of exhaustive inferences. In *Experimental Perspectives on Presuppositions*, 135–156. Springer.

Djärv, Kajsa, & Hezekiah Akiva Bacovcin. 2017. Prosodic effects on factive presupposition projection. In *Proceedings of Semantics and Linguistic Theory (SALT) XVII*, 116–133.

Heim, Irene. 1983. On the projection problem for presuppositions. In *Proceedings of the Second West Coast Conference on Formal Linguistics*, 114–25.

Murray, Sarah E. 2014. Varieties of update. *Semantics and Pragmatics* 7:1–53.

Roberts, Craige. 2012. Information structure in discourse: Towards an integrated formal theory of pragmatics. *Semantics and Pragmatics* 5:1– 69.

Rohde, Hannah, Andrew Kehler, & Jeffrey L Elman. 2007. Pronoun interpretation as a side effect of discourse coherence. In *Proceedings of the Annual Meeting of the Cognitive Science Society*, volume 29, 617–622.

van der Sandt, Rob A. 1992. Presupposition projection as anaphora resolution. *Journal of Semantics* 9:333–377.

Simons, Mandy, Judith Tonhauser, David Beaver, & Craige Roberts. 2010. What projects and why. In *Proceedings of Semantics and Linguistic Theory (SALT) XXI*, 309–327.

Snider, Todd. 2017. At-issueness$\neq$anaphoric availability. In *Proceedings of the Linguistic Society of America*, volume 2, 39–1.

Stevens, Jon, Marie-Catherine de Marneffe, Shari R. Speer, & Judith Tonhauser. 2017. Rational use of prosody predicts projection in manner adverb utterances. In *Proceedings of the 39th Annual Meeting of the Cognitive Science Society*.

Syrett, Kristen, & Todor Koev. 2015. Experimental evidence for the truth conditional contribution and shifting information status of appositives. *Journal of Semantics* 32:525–577.

Tonhauser, Judith. 2012. Diagnosing (not-) at-issue content. *Proceedings of Semantics of Under-represented Languages of the Americas (SULA)* 6:239–254.

Tonhauser, Judith. 2016. Prosodic cues to speaker commitment. In *Proceedings of Semantics and Linguistic Theory (SALT) XXVI*, 934–960. Ithaca, NY: CLC Publications.

Tonhauser, Judith, Judith Degen, & David Beaver. 2018. How projective is projective content? Gradience in projectivity and at-issueness. *Journal of Semantics* 35:495–542.

Xue, Jingyang, & Edgar Onea. 2011. Correlation between presupposition projection and at-issueness: An empirical study. In *Proceedings of the ESSLLI 2011 Workshop on Projective Meaning*, 171–184.

Zondervan, Arjen, Luisa Meroni, & Andrea Gualmini. 2008. Experiments on the role of the question under discussion for ambiguity resolution and implicature computation in adults. In *Proceedings of Semantics and Linguistic Theory (SALT) XVIII*, 765–777.