

Speaker-Oriented Additives

Yaxuan Wang and Brian Buccola*

1 Introduction

An intriguing proposal in presuppositions is that attitude verbs exhibit belief projection. That is, presupposition triggers within the attitude's scope imply that the subject believes the presupposition. In (1), the complement of the attitude verb Bill stopped smoking presupposes Bill used to smoke, as suggested by the negation diagnostic of presuppositions in (2). The belief entailment that John believes that Bill used to smoke persists under negation as well, shown in (3).

- (1) John believes that Bill stopped smoking.
- (2) Bill didn't stop smoking.
→ Bill used to smoke.
- (3) John doesn't believe that Bill stopped smoking.
→ John believes that Bill used to smoke.

The predominant dynamic approach to presuppositions comprises two essential theories that predict the belief projection: the satisfaction theory and the binding theory. On the satisfaction theory (e.g. Karttunen 1974, Heim 1983), presuppositions place constraints on recursively derived bodies of information, the *local context*. For example, the local context of a negation sentence is the global context. Thus, the satisfaction theory predicts (2) is felicitous only if it is taken for granted by the conversation participants the presuppositions project out of negation. For triggers under attitude verbs like (1), the local contexts of attitude reports are taken to be the subject's beliefs. Therefore, the presuppositions triggered in the scope of attitude verbs project into the subject's beliefs. The belief projection is thus always predicted. On the binding theory (e.g. Geurts 1999), presuppositions are assumed to be part of the logical form of a sentence that can be anaphoric on other parts. When no antecedent for the presupposition exists within an operator's scope, the presupposition continues to seek one in wider scopes. Hence, the presupposition triggered under negation is predicted to project. Regarding attitude verbs, the binding theory allows presuppositions triggered in a subject's beliefs to be bound either at the matrix level or in the subject's beliefs. When bound in the subject's beliefs, the belief projection is derived, which we will refer to as *de dicto* reading in the rest of the paper; when bound at the matrix level, the presupposition projects out of the attitude scope, and the *de re* reading is thus derived. Briefly, the satisfaction theory predicts a presupposition under attitude verbs' scope must receive *de dicto* reading, while the binding theory allows for both *de dicto* and *de re* readings.

One observation taken to argue for the binding theory but against the satisfaction theory is the puzzle related to additives under attitude verbs. As first pointed out by Heim (1992), presuppositions triggered by *even*, *too*, and *also* do not pattern with belief projection. These expressions are usually taken to trigger presuppositions linked to aspects of the conversational context, but these presuppositions needn't constrain a subject's beliefs. For instance, consider Mary's response in (4):

- (4) Context: John and Mary are talking to each other over the phone.
-John: I am already in bed.
-Mary: My parents think I am also in bed.

It is well accepted that the presupposition triggered by *Mary is also in bed* is that there is a conversationally salient proposition to the effect that someone other than Mary is in bed. Thus, based on the arguments proposed by belief projection, Mary's response is only acceptable if Mary's parents believe that salient proposition. But Mary's response is felicitous, even if her

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parents do not believe that John or anyone else is in bed. Replacement of think with other attitude verbs gives rise to the same felicitous response, which suggests that also embedded within the scope of attitude verbs does not necessarily pattern with belief projections.

Although the binding theory succeeds in accounting for the additives' projection behavior, it faces serious overgeneration problems (Blumberg 2023): it allows other presuppositions, such as the exclusive presupposition triggered by *only*, to project out of attitude verbs and thus receive a *de re* reading, which is a wrong prediction.

In this paper, we argue that under the satisfaction theory framework, the additives' belief projection puzzle can be solved by adopting a Conventional Implicature (henceforth, CI) operator. We propose this CI operator is the covert counterpart of the expression *I think* and acts as a type shifter. It bifurcates a meaning function into an at-issue dimension with an at-issue type and a conventional implicature dimension with a CI type, where the set of types is inherited from Potts (2004). The at-issue dimension is further constrained by requiring an identity function. When the discourse context is not consistent with the *de dicto* interpretation of the additive under attitude verbs, the CI operator is attached to the additive and shifts the presupposition into the CI dimension. The type mismatch between the presupposition which is of CI type and the attitude verb which is of at-issue type thus gives rise to the *de re* reading. The current solution under the satisfaction theory framework does not suffer from the overgeneration problem, as the at-issue dimension of CI operator requires an identity function, which most presupposition triggers do not assert. The proposed CI operator can also be extended to account for the *de re* and *de dicto* readings of speaker-oriented expressions, such as appositives and expressives.

The paper is structured as follows. Section 2 reviews the satisfaction theory and the binding theory, and the problems they face respectively. Section 3 presents our proposal, where we compare properties of additives, appositives, and expressives, develop the bidimensional approach to CI, and propose the CI operator. Section 4 concludes the paper.

2 Relevant Theories

2.1 The Satisfaction Theory

Under the satisfaction theory framework, the meaning of a sentence is its context change potential (henceforth, CCP), a function from context to context. Presuppositions of a sentence are requirements on the context. A sentence's CCP can apply to a context only when the context already entails the presupposition it carries. The presupposition projection is thus a by-product of the way that the CCP of a complex sentence is composed from the CCPs of its parts. Turning to belief projections, a definedness condition for belief reports is as follows:

- (5) For any context c , $c + \alpha$ believes φ is defined only if $Dox_\alpha(w) + \varphi$ is defined for each $w \in c$. When defined, $c + \alpha$ believes $\varphi = \{w \in c: Dox_\alpha(w) + \varphi = Dox_\alpha(w)\}$.

In plain English, the definition in (5) is read as: for any context c , c can be updated with the proposition that α believes φ only if in each possible world w of c , φ is defined in α 's beliefs. When c updated with α believes φ is defined, c updated with α believes φ is the set of worlds in c in which α believes φ .

If the CCP of φ is defined only for contexts that entail a certain proposition p , then the CCP of α believes φ is defined only for those c all of whose elements w map onto $Dox_\alpha(w)$ entail p . In other words, if φ presupposes p , then α believes φ presupposes that α believes p . Take (6) for example:

- (6) John believes that Mary is here, and he believes that Susan is also here.

For any context c , $c + Susan$ is also here is defined only if Mary is here in every world in c . When defined, $c + Susan$ is also here = $\{w \in c: Susan$ is here in $w\}$. For any context c , $c + John$ believes Mary is here = $\{w \in c: Mary$ is here in all $w' \in Dox_J(w)\}$. By the definedness condition (5), the updated $c' + John$ believes Susan is also here is defined only if $Dox_J(w) + Susan$ is also

here is defined for every $w \in c'$. When defined, $c' + \text{John believes Susan is also here} = \{w \in c: \text{Susan is here in all } w' \in \text{Dox}_J(w)\}$.

Heim's example in (4), therefore, poses a serious challenge for the satisfaction account. As required by its arguments, that Mary's parents believe there is someone other than Mary in bed must be already entailed by Mary's parents' belief worlds, otherwise, Mary's utterance would not be defined thus infelicitous as a continuation. But this contradicts our intuition toward the naturalness of the conversation.

2.2 The Binding Theory

The most popular account in the Binding Theory is Discourse Representation Theory (henceforth, DRT). In DRT, interpretation functions operate on Discourse Representation Structures (henceforth, DRSs). A DRS consists of a universe of discourse referents and a set of conditions. Presuppositions are encoded in separate DRSs labeled PRES, which are generated at the site of the presupposition trigger. A simple DRS with presupposition is given in (7a), where the PRES represents an event e of Bill smoking. Presuppositions triggered in one DRS can be bound in an accessible DRS where an appropriate antecedent is available, as shown in (8). Presupposition resolution algorithms dictate that the presupposition should be bound with the antecedent, which involves equating the event e with the event e' , as in (8b). For presuppositions with no appropriate antecedent, there is a preference for presuppositions to be bound in the lowest accessible DRS, otherwise, there is a preference for presuppositions to percolate up to the highest accessible DRS. This gives effects of projection, as in (9).

- (7) Bill stopped smoking.
 a. $[x: \text{Bill}(x) [\text{stop}(x, e) [\text{PRES } e: \text{smoke}(e, x)]]]$
- (8) Bill used to smoke. He now stopped smoking.
 a. $[x: \text{Bill}(x) [e: \text{smoke}(e, x), \text{stop}(x, e') [\text{PRES } e': \text{smoke}(e', x)]]]$
 b. $e' = e$, thus, $[x: \text{Bill}(x) [e: \text{smoke}(e, x), \text{stop}(x, e)]]]$
- (9) Bill didn't stop smoking.
 a. $[x: \text{Bill}(x) \neg[\text{stop}(x, e) [\text{PRES } e: \text{smoke}(e, x)]]]$
 b. $[x: \text{Bill}(x) [\text{PRES } e: \text{smoke}(e, x)] \neg[\text{stop}(x, e)]]]$

As for attitude verb cases, the binding theory maintains that the matrix context is accessible to attitude contexts so that presuppositions triggered in attitudes may percolate up to the matrix DRS. It also maintains that presuppositions triggered inside a subject's attitude scope may be bound in their beliefs. To explain (4), when the presupposition that there is a conversationally salient proposition to the effect that someone distinct from Mary being in bed remains in the belief scope, as in (10a), it gives rise to the belief projection; when it percolates up to the matrix DRS where an antecedent is available, presupposition resolution algorithms dictate that the presupposition should be bound there, as in (10b). The resolved DRS has no unresolved presuppositions, and this explains why the discourse does not presuppose Mary's parents believe John is in bed.

- (10) - John: I'm already in bed.
 - Mary: My parents think I'm also in bed.
 a. $[x: \text{John}(x), \text{sleep}(x) [y: \text{parent}(y), [\text{BEL } z: \text{Mary}(z), \text{sleep}(z) [\text{PRES } : \exists u \neq z \text{ such that } \text{sleep}(u)]]]]]$
 b. $u = x$, thus, $[x: \text{John}(x), \text{sleep}(x) [y: \text{parent}(y), [\text{BEL } z: \text{Mary}(z), \text{sleep}(z)]]]$

However, the binding theory suffers from overgeneration problems, as illustrated by Blumberg (2023) repeated in (11). The presupposition triggered by only in (11a)'s prejacent, namely, Sue will come to the party, can be bound at the matrix level by the claim that Sue will come. The overall effect is that (11a) should be equivalent to (11b), which is not the case. In other words, the binding theory has to provide a constraint that allows only the presupposition of additives but not that of other triggers to percolate up and be bound at the matrix DRS.

- (11) Sue will come to the party, but Bill is sure that she won't.

- a. #He is sure that only Sue will come to the party.
- b. He is sure that nobody else will come to the party either.

To summarize, the satisfaction theory predicts that the additives under attitude verbs only receives the *de dicto* reading, an undergeneralization to be expanded; while the binding theory generally allows any presuppositions to project out of the scope of attitude verbs, suffering from overgeneralization problems. In the following section, we provide a solution to the puzzle under the framework of the satisfaction theory to fix its undergeneralization problem.

3 Proposal Under The Bidimensional Framework

3.1 Additives Share Properties with Appositives and Expressives

It was agreed by many studies (e.g. Asher 2000, Potts 2004) that appositives and expressives always behave as speaker-oriented expressions and take the widest scope. However, it was later argued that the interpretation of those expressions can be in the scope of particular operators. For example, Wang et al. (2005) observed that the appositive under attitude verb *believe* in (12) can be interpreted either as John believes there is a famous professor or as the speaker of (12) believes there is a famous professor. Potts's (2004) example in (13) shows that when *lovely* is used as an expressive adjective under the attitude verb *say*, it can be ambiguous in that either the speaker Edna but not the subject Chuck thinks the vases are lovely or Chuck thinks the vases are lovely. In other words, appositives and expressives can either elicit speaker-centered construals or give rise to *de dicto* readings. This observation resembles the behavior of additives under attitude verbs as we have seen in Heim's famous example.

- (12) John believes that a professor, a quite famous one, published a new book.
- (13) Edna: "Chuck said I could have one of his lovely vases!"

Moreover, appositives, expressives, and additives are all able to carry non-at-issue information. Simons et al. (2010) propose that (non-)at-issueness is relevant to determining whether a content can survive embedding under operators. They hypothesize that a projective content is one that is non-at-issue, with the term "at-issue" defined as follows: A proposition p is at-issue iff the speaker intends to address the Question Under Discussion (henceforth, QUD) via $?p$, where $?p$ is felicitous to use only if $?p$ is relevant to the QUD, and the speaker can reasonably expect the addressee to recognize this intention. We can use this definition to find out which part of the utterances in (14) is (non-)at-issue. Assume the QUD for (14a) is *Who won the 2003 Tour de France?* Since the question *Is Lance Armstrong an Arkansan?* is not relevant to the QUD, i.e., neither a positive nor a negative answer to the question contextually entails an answer to the QUD, the proposition p that Lance Armstrong is an Arkansan is non-at-issue. For (14b), the QUD is *What happened to Amy's dog?* The proposition p that Amy's dog is bad is non-at-issue, because $?p$ *Is Amy's dog bad?* is irrelevant to the QUD. Similarly, the QUD of (14c) is *Who else besides John went skiing?* The question *Did John go skiing?* is not relevant to the QUD.

- (14) a. Lance Armstrong, an Arkansan, won the 2003 Tour de France.
(Potts 2004)
- b. Amy's damn dog died.
- c. (John went skiing...) Bill also went skiing.

An alternative test for (non-)at-issueness is that at-issue content can be directly assented or dissented with, whereas non-at-issue content cannot (Tonhauser, 2012). As shown below, the denial of the appositive in (15a), the expressive in (15b), and the additive presupposition in (15c) are all infelicitous, which suggests they are non-at-issue.

- (15) a. - Lance Armstrong, an Arkansan, won the 2003 Tour de France.
- No, he didn't win! #No, he is not an Arkansan!
- b. - Amy's damn dog died.

- No, it didn't die! #No, Amy's dog is not bad!
- c. (John went skiing...) Bill also went skiing.
- No, Bill didn't go skiing! #No, John didn't go skiing!

Lastly, when apposives, expressives, and additive presuppositions are non-at-issue, their truth value is independent of the at-issue content they attach to. As shown by (16a-c) adapted from Kubota & Uegaki (2009), even with the explicit falsity of the appositive, expressive, and additive non-at-issue part, the truth value of the at-issue proposition can still be determined. By contrast, a canonical presupposition like *stop* in (16d), with both the at-issue and non-at-issue content are closely related to a single lexical item, shows a dependency between the two dimensions of meaning. When the presuppositional non-at-issue content is false, it is hard to give a yes or no answer to the question. Although presupposition failures are typically seen to lead to a situation in which the sentence lacks a truth value, the comparison between (16c-d) suggests that the landscape of presuppositions is too complicated to be concluded with this general assumption. Nuanced investigation into specific triggers is required. Moreover, some presupposition triggers such as those with additive presuppositions exhibit linguistic properties resembling both presuppositions and conventional implicatures, which suggests that there is no clearcut boundary between the so-defined categories of inferences.

- (16) a. - Did Lance Armstrong, an Arkansan, win the 2003 Tour de France?
 - Yes, he won. But he is not an Arkansan.
 b. - Did Amy's damn dog die?
 - Yes, it died. But that is not a bad dog.
 c. - Did Bill also go skiing?
 - Yes, he did. But no one else went skiing.
 d. - Did John stop smoking?
 - #Yes, he did. But he never smoked.

This section proposes that additive particles share linguistic properties with apposives and expressives, which are both canonical conventional implicature expressions: they allow for both *de re* and *de dicto* readings under attitude verbs, they can carry non-at-issue information, and their truth value is independent of the at-issue proposition they attach to. In the next section, we develop a bidimensional approach to solve this *de re/de dicto* alternation puzzle.

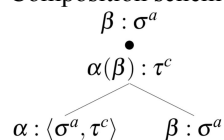
3.2 Potts's Bidimensional Approach Requires Flexibility

Inspired by Karttunen & Peters (1979), Potts (2004) developed a bidimensional approach to account for the behaviors of conventional implicatures (henceforth, CIs). He reduces the at-issue vs. CI divide to a fact about the types. The set of types is listed in (17).

- (17) a. at-issue types: $e^a, t^a, s^a, \langle \sigma^a, \tau^a \rangle$
 b. CI types: $e^c, t^c, s^c, \langle \sigma^a, \tau^c \rangle$

The basic composition scheme is presented in (18). The heart of the proposal is a composition rule that has two parts: (i) apply a CI functor α to an at-issue argument β to form a conventionally implicated proposition $\alpha(\beta)$; and (ii) output the at-issue argument β unmodified, as a meaning that is independent of the proposition in (i). The bullet \bullet is a metalogical symbol for separating two dimensions of meaning.

- (18) Composition scheme

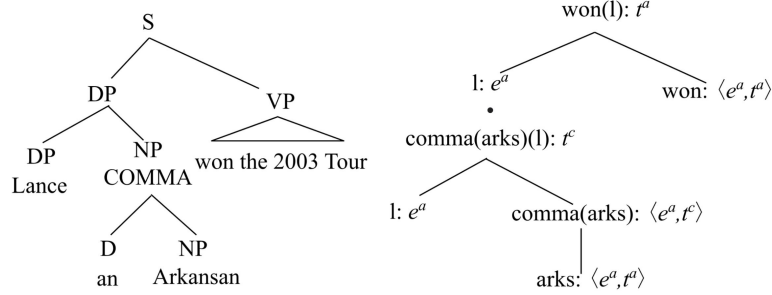


A special rule Potts proposed is feature semantics, which is for representing the semantic

contribution of certain syntactic features. This rule allows for switching an at-issue content to a CI content. For example, The appositives are distinguished by a feature *COMMA*, accounting for the intonational boundary marks in speech. Its denotation is presented in (19). One typical example of its application is illustrated in (20). In the composition procedure, the proposition *Lance* is an *Arkansan* is converted to a CI type and is not inherited by dominating nodes because of the type mismatch.

$$(19) \llbracket \text{COMMA} \rrbracket = \lambda f \lambda x. f(x) \quad \langle \langle e^a, t^a \rangle, \langle e^a, t^c \rangle \rangle$$

$$(20) \text{Lance, an Arkansan, won the 2003 Tour.}$$



Since the comma intonation is necessarily associated with appositives, it predicts that an appositive always receives a *de re* reading no matter what operator scopes over it. However, as we have seen earlier in Section 3.1, at least under attitude verbs, depending on the conversational context, appositives can be interpreted as either *de dicto* or *de re*.

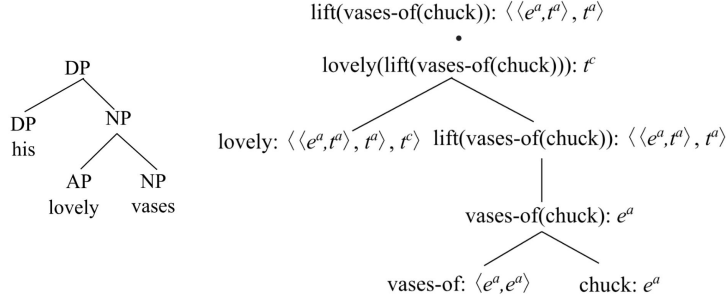
The expressives are assumed to have a grammaticalized CI type. Potts offers a general lexical entry for some expressive adjectives (henceforth, EAs), which take any at-issue argument to produce a CI, as in (21).

$$(21) \llbracket \text{damn/bloody/fucking/...} \rrbracket = \lambda X. \text{bad}({}^\cap X)^1 \quad \langle \langle \sigma^a, t^a \rangle, t^c \rangle$$

Potts argues that the CI type of expressives is endorsed by the fact that EAs are unable to appear in predicative position, as in **Eduardo is damn*, or are not gradable, as in **that's a very damn dog*. The logic is that CIs are strictly output types. However, in addition to the canonical EAs, there are many adjectives that express subjective judgments, which alternate between at-issue and CI readings. An example is illustrated in (22) from Potts (2004). There is an obligatory mismatch between the sister to *lovely* in the syntax and in the semantics: In LF, *Chuck's vases* is lifted. *Lovely* as an EA has type $\langle \langle \sigma^a, t^a \rangle, t^c \rangle$ and scopes over the DP. This analysis seems to assume *lovely* is lexically ambiguous in the lexicon, one of which has the at-issue type, the other has the CI type. Such an assumption has to hypothesize that all adjectives expressing subjective judgments are lexically ambiguous, which is likely to miss an important generalization.

(22) Edna is at her friend Chuck's house. Chuck tells her that he thinks all his red vases are ugly. He tells Edna that she can take one of his vases. Edna thinks the red vases are lovely, selects one, and returns home to tell her housemate, "Chuck said I could have one of his lovely vases!"

¹The nominalizing type shifter ${}^\cap$ takes any function and returns the plural individual composed of all members of the input set. ${}^\cap = \lambda X. \iota x [\forall y [X(y) \leftrightarrow y \leq x]]$: $\langle \langle \sigma^a, t^a \rangle, e^a \rangle$, where \leq is the *part of* relation and ι is the definite operator.



To summarize, Potts’s bidimensional approach to CIs is promising but needs some flexibility to account for the more nuanced data. In the following section, we propose a modification to the approach which is able to make correct predictions for the optional belief projection of appositives, expressives, and additives.

3.3 Develop The Bidimensional Approach Under The Satisfaction Theory

Given that additives, expressives, and appositives can alternate between *de re* and *de dicto* readings, we propose a CI operator that functions as a type shifter as defined in (23). It takes any argument with type $\langle \sigma^a, t^a \rangle$ and bifurcates it into two dimensions: the at-issue meaning component goes to the at-issue dimension with type $\langle \sigma^a, t^a \rangle$; and the non-at-issue meaning component goes to the non-at-issue dimension with type $\langle \sigma^a, t^c \rangle$. The denotation also requires the at-issue dimension to be filled with an identity function, which captures the intuition that a CI expression merely attach to and “comments on” the at-issue content instead of modifying it. There are generally two ways to identify the at-issueness of the meaning: for presupposition triggers like *also* and canonical EAs like *damn*, the at-issueness has already been encoded in the semantics; for other expressions like appositives and adjectives expressing subjective judgments like the aforementioned *lovely*, discourse participants need to consult the QUD.

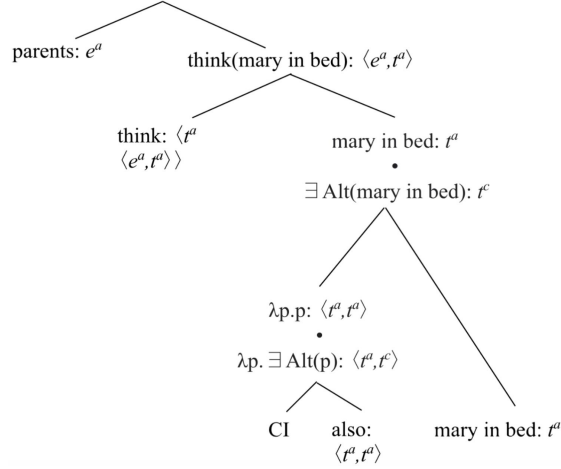
$$(23) \llbracket \text{CI} \rrbracket = \lambda f_{\langle \sigma^a, t^a \rangle} \cdot g_{i(\sigma^a, t^a)} \bullet g_{\langle \sigma^a, t^c \rangle} \text{ where } g_i \text{ is an at-issue identity function, and } g \text{ is not-at-issue whose semantics is whatever encoded in the not-at-issue content.}$$

Schlenker (2023) argues that an eliminable constituent must be possibly entailed in its local context whereby the local context c' of an expression E is defined as the minimal domain of objects that the interpreter needs to consider when he attempts to compute the meaning of a sentence. By virtue of this definition and that the additive presuppositions, appositives, and expressives never modifies their at-issue dependent, thus, they are eliminable, we assume that they force interpretation in their local context. As originally assumed by the satisfaction theory, the local context of attitude reports is taken to be the subject’s beliefs. When the local context of attitude reports does not entail or is not consistent with the reports in additives, appositives, and expressives, the CI operator is attached to the expressions in question so that comprehenders can successfully accommodate the speaker’s utterance.

For instance, the *de re* and the *de dicto* reading of *also* in (24a) are derived as follows: in a context where the discourse participants share the common knowledge that Mary’s parent believes that someone other than Mary is in bed, or the comprehender is not opinionated about this knowledge, the comprehender prefers the *de dicto* interpretation of *also*, in which case the presupposition is satisfied in its local context. By contrast, in a context where the comprehender thinks it is not the case that Mary’s parent believes that someone other than Mary is in bed, they then tries to accommodate the presupposition by adopting the CI operator. The operator attaches to *also*, and bifurcates its semantics into two dimensions for interpretation: the assertion $\lambda p.p$ is an at-issue identity function, thus goes to the at-issue dimension with type $\langle t^a, t^a \rangle$, while the additive presupposition function is not at-issue, thus goes to the CI dimension with type $\langle t^a, t^c \rangle$. Since the attitude verb *think* takes only at-issue types, the type mismatch gives rise to the effect that the presupposition is evaluated outside of the subject’s beliefs, in other words, the matrix context now

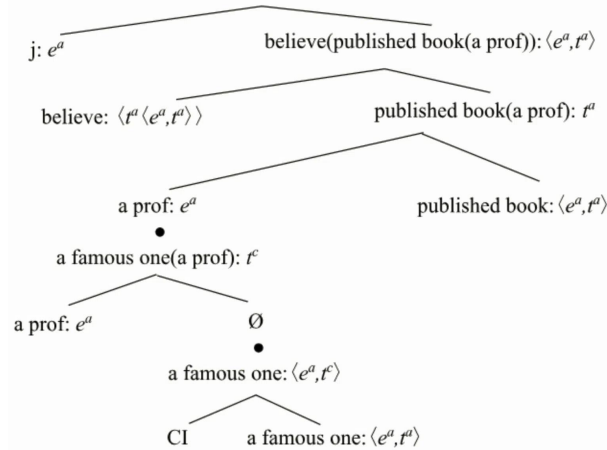
serves as the local context of the presupposition. Since the matrix context entails the additive presupposition, the *de re* reading of additives arises.

- (24) a. Mary's parents think Mary is also in bed.
 b. $\llbracket \text{also} \rrbracket = \lambda p: \exists q \in \text{Alt}(p)[q]. p$
 $\text{think}(\text{mary in bed})(\text{parents}): t^a$

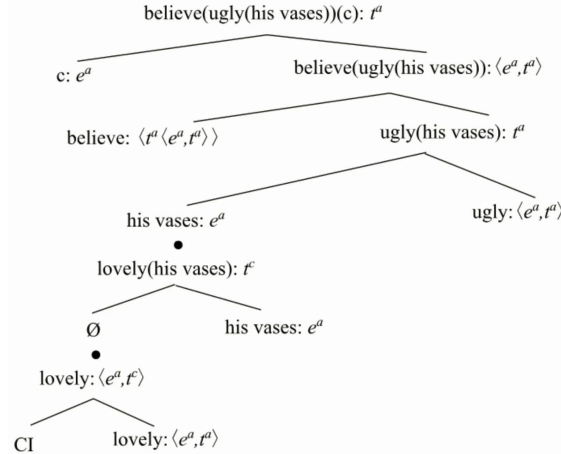


Similarly, for the appositive in (25) and the expressive adjectives in (26), when the discourse context contradicts the prejacent of the attitude verb *believe*, the comprehender would choose to adopt the CI operator to accommodate the speaker's utterance. The operator attaches to the appositive/the expressive and bifurcates the predicate into two dimensions. Since there is no at-issue content carried by the expression, the at-issue dimension remains blank. Following Potts (2004), this is realized by default as an identity function. Again, the type mismatch gives rise to the *de re* reading of the appositive/the expressive. The current proposal avoids Potts's issue of attributing ambiguous lexical meanings to adjectives.

- (25) John believes that a professor, a quite famous one, published a new book.
 $\text{believe}(\text{published book}(\text{a prof}))(j): t^a$



- (26) Chuck believes his lovely vases are ugly.



The current analysis makes a satisfactory prediction that other presupposition triggers, such as *only*, behave differently from additives and always pattern with belief projection, as repeated in (27a). The property that the CI expression merely “comments on” the at-issue content instead of modifying it requires an identity function in the at-issue dimension. In the semantics of *only*, as given in (27b), the at-issue component is not an identity function. Rather, it adds novel information to the discourse context to resolve the QUD that besides Sue, who else will come the party. The CI operator thus never applies to *only* to derive the speaker-oriented reading.

- (27) a. Bill is sure that only Sue will come to the party.
 → Bill is sure that Sue will come to the party.
 b. $\llbracket \textit{only} \rrbracket = \lambda p: p. \forall q \in \text{Alt}(p)[q = 0]$.

In addition, we argue that the lexical realization of the covert CI operator is the expression *I think*. For example, the speaker can add *I think* to the appositive to disambiguate the sentence in (28) to express only the *de re* meaning. The difference between *I think* and the CI operator is that the former puts more restrictions on the input argument type, which is required to be a proposition $\langle t \rangle$. It cannot directly attach to an expressive $\langle e, t \rangle$ or an additive $\langle t, t \rangle$, but the covert operator can.

- (28) John believes that a professor, who I think is a quite famous one, published a new book.

4 Conclusion and Final Discussions

Additive particles behave differently from other presupposition triggers in the sense that the former allows both *de re* and *de dicto* readings when embedded under attitude verbs while the latter only obtains *de dicto* interpretations. The binding theory makes felicitous predictions for belief projections of additives, but overgenerates the belief projection patterns for other presupposition triggers. The satisfaction theory predicts all presuppositions are interpreted in the local context of attitude reports, thus needs an explanation for the alternate readings derived from additives. Following Potts’ (2004) bidimensional approach to conventional implicatures, we argue that Potts’ feature semantics interpretation rule should be replaced by the CI operator that resembles the expression *I think*. The CI operator is licensed only if the discourse context cannot accommodate the local interpretation. Attaching the CI operator to additives, we have an identity function on the at-issue dimension and the presupposition on the CI dimension. The mismatch in types between the presupposition and the attitude verbs gives rise to the *de re* reading. The same derivation applies to appositives and expressives and aligns with the observation that appositives and expressives also have alternate interpretations.

One puzzle remains for the bidimensional approach in general is the binding problem. As shown in (29), when the embedded clause is bound by a quantifier, the *de re* reading is available, but it is mysterious how to have the pronoun variable bound in a different dimension of meaning.

Previous studies on quantificational presuppositions suggest that when projective content contains a bound variable, it does not get filtered through quantifier operators (e.g., Fox 2013; Wang and Buccola 2023). This evidence indicates a technical challenge for the bidimensional framework in providing a properly defined semantics for generalized quantifiers. One approach we attempt is illustrated in (30), where generalized quantifiers are treated as having a type across multiple dimensions, allowing variables in different dimensions to be bound by the same quantifier. Future research is necessary to explore this direction further.

- (29) a. Some student_i believes that they_i also passed the exam.
 b. Edna: “Some boy_i said I can take their_i lovely vases!”
 (30) *Quantifier*: $\langle e^a t^a \langle \langle e^a t^a \rangle t^a \rangle \rangle \bullet \langle e^a t^a \langle \langle e^a t^c \rangle t^c \rangle \rangle$

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Department of Linguistics, Languages, and Cultures
 Michigan State University
 Michigan, MI 48912
 wangyax3@msu.edu
 buccola@msu.edu