Meaning Projection

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This chapter explores the phenomenon of meaning projection, i.e., the ability of certain implications to convey speaker commitments (or those of some external agent) even when the triggering expression occurs in the syntactic domain of an entailment-canceling operator. We begin by distinguishing projection from two closely related concepts: scope (the position where an operator is interpreted, which may differ from its surface position) and perspective (the epistemic state to which semantic content is attributed). We then turn to the behavior of two kinds of projective meanings: presupposition (information that is presented as taken for granted) and conventional implicature (information that is presented as new yet potentially non-relevant). The bulk of the chapter is devoted to approaches to projection, including those based on wide scope, bi-dimensionality, partiality, dynamicity, and at-issueness. Attention is also paid to projection variability, or the degree to which projective inferences tend to project.

1. Preliminaries: Projection, scope, perspective

The term PROJECTION, coined by Langendoen and Savin (1971), describes implications that are lexically triggered and remain anchored to the epistemic state of the speaker (or some non-local agent) regardless of the specific linguistic environment. More specifically, if a sentence carries an implication that persists when its triggering expression occurs in the syntactic domain of an entailment-canceling operator (e.g., negation, a modal element, a conditional complementizer, or a question operator), we say that this implication projects. Intuitively, projected meaning encompasses implications that are robust and more difficult to subdue than the logical entailments of the sentence.

      The following examples illustrate the phenomenon of projection and how projected implications differ from logical entailments.[1] From the positive sentence in (1a) we can infer both (2a) and (2b). However, these two implications are not on a par. This is evident from the fact that, unlike (1a), its negative counterpart (1b) implies (2b) but not (2a). We may conclude that (2b), unlike the logical entailment in (2a), projects past negation.

(1)   a. The king of France is bald.
          b. The king of France isn't bald.

(2)   a. Someone is bald.
          b. France has a king.

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[1] Many of the linguistic examples cited in this article are drawn from seminal papers and have been widely used in subsequent literature. To improve readability and maintain focus on the analysis, I will not reference the original sources.

In a similar vein, (3a) implies both (4a) and (4b). However, when (3a) is negated, as in (3b), the implication in (4a) melts away, whereas the one in (4b) survives. This suggests that the latter implication, unlike the former, exhibits projective behavior.

(3)   a. Edna, a fearless leader, started the descent.
       b. Edna, a fearless leader, didn't start the descent.

(4)   a. Someone started the descent.
       b. Edna is a fearless leader.

Projection needs to be distinguished from two closely related concepts: scope and perspective. Starting with the former, SCOPE is a fundamental property of natural language and concerns the problem of how operators find their semantic arguments, i.e., how they find the part of the meaning on which they perform their action. In general, the scope of an operator results from some larger expression that encloses it. Yet often the surface position of an operator does not match the position required to produce the desired interpretation. A classic example of a scopal ambiguity is cited in (5), which has two readings: the surface scope reading in (5a) and the reverse scope reading in (5b).

(5)   Someone loves everyone.
       a. 'There is at least one person such that this person loves everyone.'
       b. 'For every person there is a person whom the first person loves.'

To match operators with their scope, several formal mechanisms have been proposed. These include Quantifying In (predicates are fed free variables as arguments, these variables are abstracted over, and quantifiers are merged with the resulting property in different orders; Montague 1973), Quantifier Raising (quantifiers are merged into their surface position but are covertly raised and attached to their scope; May 1977; Heim & Kratzer 1998), and Flexible Types (quantifiers remain in surface position and type-shifting rules are applied to derive the different scopings; Hendriks 1993; Barker & Shan 2014). Formal details aside, the key point is that projection is, in some sense, the opposite of scope. Scope is primarily a matter of compositional semantics: we structurally match operators with their potential semantic arguments to derive attested interpretations. The lexical semantics of an operator is typically insufficient to determine whether it takes narrow, intermediate, or wide scope relative to other scope-bearing elements. In contrast, projection is primarily a conventional property of languages that arguably does not involve compositional interaction. Projection is baked into the semantics of expressions, meaning that a projective inference will be launched as soon as a sentence

contains a word or construction with that property.[2] In fact, projected content is so called precisely because it escapes the domain of operators.

Compared with projection and scope, PERSPECTIVE is the most elusive concept and might not even constitute a uniform phenomenon. Broadly speaking, perspective concerns the ability of semantic content to be tied to a modal scenario or the mental state of an agent without relying on conventional mechanisms like lexical triggering or semantic composition. Perhaps the best way to understand perspective is a phenomenon where the semantics of an expression has certain degrees of freedom that are resolved through subtle contextual factors.

Perspective is at stake in various empirical phenomena, such as predicates of personal taste and subjectivity (Lyons 1977; Kölbel 2004; Lasersohn 2005; Stephenson 2007; Sæbø 2009; Pearson 2013; Kennedy & Willer 2016; Coppock 2018; Anand & Korotkova 2022; Koev 2024; a.o.), shiftable indexical pronouns (Rice 1986; Speas 1999; Schlenker 2003; Anand 2006; Sudo 2012; Deal 2020; a.o.), free indirect discourse (Banfield 1982; Doron 1991; Schlenker 2004; Eckardt 2015; Maier 2015; Sharvit 2018; a.o.), and modal subordination (Karttunen 1976; Roberts 1989; Geurts 1999; Asher & McCready 2007; Brasoveanu 2010; a.o.). The theoretical approaches to these phenomena are likely too diverse to be streamlined into a single coherent story. Still, there seems to be a common thread. At some level of generality, all approaches involve some extra parameter that accounts for the availability of an additional perspective, be it a judge parameter (Lasersohn 2005), a secondary speech context (Schlenker 2003), a modal domain (Roberts 1989), or similar. Perspective-sensitive phenomena thus involve some form of underdetermination that must be resolved by the context. While projection is also anchored to an intensional context, it is more restricted in that it targets the epistemic state of the speaker (or the narrator). In this sense, projection can be viewed as a special case of perspective-taking.

2. Projection empirically

Projection has been extensively studied in relation to two major linguistic phenomena: presupposition and conventional implicature. Starting with the former, PRESUPPOSITION is meaning that is linguistically marked as being taken for granted by interlocuters rather than constituting the main contribution of the utterance.[3] This type of meaning was illustrated in the previous section, where both (1a) and (1b) presuppose—i.e., present as taken to hold—(2b). Presupposed meaning is encoded by a wide variety of linguistic triggers, including definite noun phrases (e.g., *the selfish ant*), cleft constructions (of the form *it was X who Y*), iteratives (*too, again*, etc.), focus-sensitive particles (*only, even, also*), factive predicates (*know, regret, be glad*, etc.), implicative verbs (*manage, remember, forget*, etc.), change-of-state aspectual verbs (*start,*

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[2] Although, see Section 4 for a brief discussion of "soft" presuppositions, which are sometimes claimed to be contextually triggered.

[3] The focus in this survey is on presupposed meaning that is *linguistically* coded as such, also called "semantic" presupposition. Stalnaker (1974) subsumes this notion under "pragmatic" presupposition, which encompasses both the linguistic and metalinguistic information that the speaker assumes they share with the listener. See also the article on approaches to scalar inferences in the current volume.

continue, *stop*, etc.), and others. Examples of sentences with triggers from each of these categories, along with their resulting inferences, are provided in (6)–(12). (Note: Capitalization indicates an obligatory focal accent, and ≫ is short for "presupposes".)[4]

(6)   Zoe caught the selfish ant.
       ≫ There is a (unique) selfish ant.

(7)   It was BUDDHA who set me free.
       ≫ Someone set me free.

(8)   Britney did it again.
       ≫ Britney has done it before.

(9)   Only FINN liked the movie.
       ≫ Finn liked the movie.

(10)   My students are glad that the semester is over.
       ≫ The semester is over.

(11)   Edward VIII managed to succeed George V to the throne.
       ≫ It was difficult for Edward VIII to succeed George V to the throne.

(12)   Jack stopped eating refined sugar.
       ≫ Jack once ate refined sugar.

In contrast to presupposition, CI (CONVENTIONAL IMPLICATURE) is projective meaning which introduces new information, albeit information that typically remains secondary to the main point conveyed by the utterance.[5] The two sentences in (3), both of which conventionally implicate (4b), exemplify this type of meaning. More generally, CIs are triggered by a subset of parenthetical expressions (including appositive relative clauses, nominal appositives, and *as*-parentheticals),[6] expressive adjectives (like *damn*), evidential markers (like *allegedly*), and

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[4] Below I cite both clear-cut and more controversial triggers. A more extensive list of apparent presupposition triggers can be found in Levinson (1983: 4.2). See also Karttunen (2016) for expressed skepticism that such lists amount to a uniform category.

[5] The label "conventional *implicature*" (Grice 1989; Bach 1999; Potts 2005) is somewhat unfortunate, since the conventional inferences it aims to capture are generally unrelated to the conversational implicatures as computed from the application of Gricean maxims. For this reason, I prefer to use the acronym CI, in the hopes of suppressing any misleading connotations in the direction of implicature computation.

[6] Koev (2022) divides parenthetical expressions into two large classes: pure and impure. PURE parentheticals, such as the ones mentioned above, may occur anywhere in the sentence and contribute projective inferences. IMPURE parentheticals—which include slifting parentheticals, utterance adverbs, and biscuit conditional antecedents—typically occur at the root level and modify components of the illocutionary force. Only the former generate CIs, and they will be the focus of interest here.

others. Some illustrations and the pertaining inferences are provided in (13)–(17) below. (+> marks the semantic relation "conventionally implicates".)

(13)   Lance, who won seven titles, admitted to doping.
        +> Lance won seven titles.

(14)   Jon Stewart, my favorite comedian, appeared on Larry King Live.
        +> Jon Stewart is my favorite comedian.

(15)   Cryptography is a blast, as Alan claimed.
        +> Alan claimed that cryptography is a blast.

(16)   I'll go walk my damn dog.
        +> The speaker has a negative attitude toward their dog.

(17)   Allegedly, Zoe is pregnant.
        +> Given what the speaker heard, Zoe is pregnant.

Since much of the existing work has been on parenthetical projection, this chapter will focus on this particular type of CI trigger.

Before proceeding, let us summarize how presupposition and CI compare. These meaning types share two main properties: they are conventionally triggered (i.e., activated by specific linguistic means), and they project inferences layered on top of the logical entailments of the sentence. Despite these similarities, presupposition and CI impose different conditions on the context, with CI presenting new information and presupposition typically presenting information as old (modulo cases of accommodation; Lewis 1979; Heim 1983; van der Sandt 1992; Beaver 2001). Furthermore, as we will see later in this section, presupposition and CI exhibit distinct projection patterns. That is, CI meaning robustly projects, whereas presuppositions are less stubborn and may fail to project from compound sentences.[7]

The standard diagnostic for projection is the FAMILY-OF-SENTENCES TEST (e.g., Chierchia & McConnell-Ginet 2000: §1.3). This test was already suggested in (1b) and (3b) for the case of negation. More broadly, the family-of-sentences test states that an implication associated with a given clause projects if that implication survives when the host clause is placed in the syntactic domain of an entailment-canceling operator, such as negation, a possibility epistemic modal, a conditional complementizer, or a question operator. For instance, the entire family in (18)

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[7] This is not to say that the boundary between presupposition and CI is always clear-cut. Sometimes the same construction, either across languages or within the same language, has been analyzed as belonging to one or the other meaning type. A prime example is the divergent analyses of grammaticalized evidential markers, discussed in Izvorski (1997), Faller (2002), Matthewson et al. (2007), Murray (2014), Koev (2017), Bary & Maier (2021), and others.

implies that France has a king, just like the base sentence in (1a). Similarly, all of the sentences in (19) imply that Edna is a fearless leader, just like the base sentence in (2a).

(18)   a. The king of France isn't bald.
        b. Perhaps the king of France is bald.
        c. If the king of France is bald, then he wears a wig.
        d. Is the king of France bald?

(19)   a. Edna, a fearless leader, didn't start the descent.
        b. Edna, a fearless leader, might have started the descent.
        c. If Edna, a fearless leader, started the descent, then we have nothing to worry about.
        d. Did Edna, a fearless leader, start the descent?

We now address the important question of when projective inferences can be canceled, first examining the behavior of presupposition in complex sentences constructed by logical connectives. It has been observed that presuppositions need not project past negation, as illustrated in (20). Since this is at odds with the negative instance of the family-of-sentences test for projection (cf. (1b)/(18a)), this behavior is often attributed to a different, "external" form of negation (Horn 1989: ch.2). We will assume this view is correct without further discussion.

(20)   The king of France isn't bald—there is no king of France!

Additionally, Karttunen (1973) noted that presuppositions associated with the second clause of a compound sentence are canceled if they are entailed by a first conjunct, negated in a first disjunct, or hypothetically assumed in a conditional antecedent. This phenomenon is exemplified in (21), where none of the sentences as a whole presupposes the existence of a bathroom, despite the presence of the definite noun phrase *the bathroom*.[8]

(21)   a. There is a bathroom and/but the bathroom is in a funny place.
        b. Either there is no bathroom or the bathroom is in a funny place.
        c. If there is a bathroom, then the bathroom is in a funny place.

In contrast to presupposition, CI cannot be canceled in a similar manner. As shown in (22), when placed in the same environments, sentences with CIs are generally infelicitous.[9] This

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[8] Notice that (21a) logically entails, yet does not presuppose, the existence of a bathroom. This becomes evident when the sentence is embedded under a possibility modal, which cancels said entailment and no projection ensues (cf. *It's possible that there is a bathroom and/but the bathroom is in a funny place*).
[9] However, consider the following seemingly felicitous example of CI cancelation through matrix negation, from an anonymous reviewer: *It's not the case that Edna, a fearless leader, started the descent, since Edna is anything but a fearless leader*.

suggests that the projective inferences remain intact and either clash with their negation (22a), or otherwise repeat information, thus leading to redundancy (22b)–(22d).

(22)   a. #Edna, a fearless leader, didn't start the descent—she is not a fearless leader.
        b. ?Being a fearless leader, Edna, a fearless leader, started the descent.
        c. ?Either she is not a fearless leader, or Edna, a fearless leader, started the descent.
        d. ?If she is a fearless leader, then Edna, a fearless leader, will start the descent.

3. Approaches to meaning projection

This section presents and critically assesses existing approaches to meaning projection. While several of these approaches were developed to make predictions about either presupposition or CI individually, discussing them together fosters a way of thinking about meaning projection as a cohesive phenomenon.

3.1. Wide scope approach

One simple solution to the projection puzzle is that the puzzle itself is an illusion: certain implications appear to project merely because their triggering expressions systematically occur outside their syntactic domain. This approach has been specifically proposed for (a subset of) parentheticals, with their wide scope being derived through attachment to a high syntactic node (Demirdache 1991; Del Gobbo 2003) or as part of the semantic interpretation (Nouwen 2014; Venhuizen et al. 2014; Martin 2016; Schlenker 2023), effectively turning them into wide scope conjuncts. The idea is sketched in (23), where a nominal appositive appears in the syntactic domain of a modal adjective but contributes an independent conjunct.

(23)   a. It's possible that Lance, a cyclist, won the title.
        b. $possible(win(lance, title)) \land cyclist(lance)$

While strongly dispreferred, low scope attachment is still available. This latter possibility is motivated by examples like (24), where an appositive relative clause appears to contribute semantic content to the conditional antecedent.

(24)   If tomorrow I called the Chair, who in turn called the Dean, then we would be in big trouble.
        ⊨ If tomorrow I called the Chair and they called the Dean, then we would be in big trouble.

One obvious challenge for this approach is explaining why parentheticals should prefer wide scope attachment over low scope attachment. In trying to respond to this challenge,

Venhuizen et al. (2014) and Martin (2016) propose that parentheticals "piggyback" on the scopal properties of their definite anchors, so that parenthetical implications inherit the tendency of definite noun phrases to take wide scope. While theoretically elegant, this anchor-centric idea faces two types of problems. First, it fails to explain why an *indefinite* noun phrase that is ambiguous between a specific (transparent, *de re*) and a non-specific reading (opaque, *de dicto*) is forced to acquire the former reading if an appositive relative clause is attached to it. This is illustrated in (25)–(26).

(25)   John wants to see a movie (that was directed by Spielberg).
       a. 'John wants to see a particular Spielberg movie (e.g., Jurassic Park).'   (specific)
       b. 'John wants to see any Spielberg movie.'   (non-specific)

(26)   John wants to see a movie, which was directed by Spielberg.
       a. 'John wants to see a particular Spielberg movie (e.g., Jurassic Park).'   (specific)
       b. #'John wants to see any Spielberg movie.'   (non-specific)

Relatedly, under this approach it remains unclear in what sense *non-nominal* anchors of parentheticals can be considered definite and hence projective, in view of examples like (27), where an appositive relative clause is attached to an adjectival phrase.

(27)   John wasn't intelligent, which Mary really was.

       Another problem for the wide scope approach is its disregard for the linear position of parentheticals. It has been observed that parentheticals are interpreted in surface position with respect to order-dependent phenomena like discourse anaphora, presupposition, and VP ellipsis (Potts 2005; AnderBois et al. 2015), where linear dependencies can seamlessly traverse the root/parenthetical boundaries as long as antecedents linearly precede their dependents. However, these links are disrupted if root clauses and parentheticals are strictly separated. The problem is illustrated in (28) for nominal anaphora, where the appositive relative clause cannot be interpreted as either fully preceding or fully following the root clause.

(28) $Sarah_x$, who_x likes $Jeremy_y$, greeted him_y.
       a. #She_x likes $Jeremy_y$ and $Sarah_x$ greeted him_y.   (appositive & root)
       b. #$Sarah_x$ greeted him_y and she_x likes $Jeremy_y$.   (root & appositive)

What such linear restrictions show is that deriving parenthetical projection should not come at the expense of disrupting the linear dependencies within the sentence: surface order and projection must be able to coexist. The fact that parentheticals participate in order-dependent phenomena in the usual way strongly suggests that they are interpreted *in situ*, despite their projective nature.

Although the wide scope approach is tailored specifically for parentheticals, it is important to point out that it stands no good chance of being extended to presupposition triggers. This is because such triggers target parts of the argument-predicate structure of the sentence, so moving the entire targeted constituent outside the scope of operators would fail to generate the correct meaning.

3.2. Two-dimensional approach

Another approach to meaning projection logically separates the asserted content and the projected inferences of the sentence, resulting in a two-dimensional semantic architecture. The legwork here is done by the compositional semantics, which shunts projective inferences into a secondary meaning dimension, thus explaining why external operators exert no effect on such inferences. This approach has been applied to both presupposition (Karttunen & Peters 1979) and CI (Potts 2005). An example for each type of meaning is given in (29) and (30).[10]

(29)   a. It's not true that even Bill likes Mary.
        b. $\langle\, \neg like(bill, mary),\ \forall x(x \neq bill \rightarrow \Pr(like(x, mary)) > \Pr(like(bill, mary)))\, \rangle$

(30)   a. Lance, a cyclist, didn't win.
        b. $\langle\, \neg win(lance),\ cyclist(lance)\, \rangle$

The two-dimensional approach improves on the wide scope approach because it does not depend on specific structural assumptions in order to derive projection. Nonetheless, it inherits one of the major problems of the wide scope approach by not making the interpretational mechanism order-sensitive. That is, it overlooks the linear order between the triggering expression and the rest of the sentence, which is of key importance, as already shown in (28).

Additionally, bi-dimensional semantic architectures are known to encounter the BINDING PROBLEM, identified in Karttunen & Peters (1979). This problem arises when a single indefinite element in the syntax contributes two existential quantifiers in the logical representation because it needs to bind variables in both meaning dimensions. The technical difficulty is illustrated in (31), where the presupposed inference is due to the factive verb *manage*. According to the proposed formal analysis, it is sufficient for one person to have succeeded George V and for another person to be difficult to do so. This makes the predicted meaning too weak because, intuitively, the sentence is referring to one and the same person.

(31)   a. Someone managed to succeed George V on the throne of England.
        b. $\langle\, \exists x(succeed(x, george)),\ \exists x(difficult(x, succeed(x, george)))\, \rangle$

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[10] For illustration purposes, the analysis in (29) considers only the scalar presupposition of *even* ('Bill is the least probable person to like Mary') and ignores its existential presupposition ('There are other people besides Bill who like Mary').

The binding problem can be replicated for parentheticals with indefinite anchors, as demonstrated in (32). Once again, the predicted meaning is compatible with a situation where one friend of mine runs the New York City Marathon and another friend of mine is a Yankees fan, whereas the sentence attributes both properties to the same individual.

(32)   a. A friend of mine, a fellow Yankees fan, ran the New York City Marathon.
          b. $\langle \exists x(friend(x) \wedge run(x)), \ \exists x(friend(x) \wedge fan(x)) \rangle$

What we really want here is a single quantifier that binds into both dimensions. However, this would bring us back to a single meaning dimension, which runs counter to the central premise of the two-dimensional approach.

      Lastly, this approach predicts that the secondary dimension makes a non-standard truth-conditional contribution to the sentence as a whole, either being ignored or resulting in the lack of a classical truth value. For presuppositions, this is as intended by Karttunen & Peters (1979), who formulate rules on how the presuppositions of larger constituents are inherited from the presuppositions of smaller constituents (see also the discussion of trivalent semantic architectures in the following subsection). However, this is clearly incorrect for CI. False appositives have been shown experimentally to exert a clear truth-conditional effect on the entire sentence (Syrett & Koev 2015), albeit somewhat moderated by their discourse relevance (Kroll & Rysling 2019).

3.3. Partiality approach

Another approach, specifically designed for presupposition projection, views presuppositions as interpretability conditions on the host sentence. That is, a sentence lacks a classical truth value (T or F) as soon as one of its presuppositions is false (Strawson 1950; see also Peters 1979; Beaver & Krahmer 2001; George 2008). This idea naturally leads to the CUMULATIVE HYPOTHESIS (Morgan 1969; Langendoen & Savin 1971), which states that the compound sentence inherits all of the presuppositions of its constituent parts, meaning that presuppositions always project to the top of the sentence. This effect is achieved through the trivalent Weak Kleene semantics for propositional connectives shown in (33) (Kleene 1952: §64). (Below, # stands for "undefined" (neither T nor F), and in bi-clausal formulas the leftmost column/topmost row lists the truth values of the first/second clause, respectively.)

(33)   WEAK KLEENE

ϕ	$\neg\phi$	$\phi \wedge \psi$	T	F	#	$\phi \vee \psi$	T	F	#	$\phi \rightarrow \psi$	T	F	#
T	F	T	T	F	#	T	T	T	#	T	T	F	#
F	T	F	F	F	#	F	T	F	#	F	T	T	#

‖ #   # # #‖ #   # # #‖ #   # #

Recalling the family-of-sentences test from section 2, Weak Kleene correctly predicts that presuppositions project past (regular) negation. However, its predictions about sentences with binary propositional connectives are inaccurate: presuppositions do not always percolate up in such sentences, as demonstrated in (21) above. In other words, even if a presupposition turns out to be false, the sentence may still have a classical truth value rather than being undefined/infelicitous.

Things notably improve with the Strong Kleene semantics for propositional connectives, shown in (34). Unlike Weak Kleene, this semantics posits that a compound sentence is undefined only if the classical truth values assigned to its parts do not suffice to assign it a classical truth value.[11]

(34) STRONG KLEENE

ϕ	$\neg\phi$	$\phi \wedge \psi$	T	F	#	$\phi \vee \psi$	T	F	#	$\phi \rightarrow \psi$	T	F	#
T	F	T	T	F	#	T	T	T	T	T	T	F	#
F	T	F	F	F	F	F	T	F	#	F	T	T	T
#	#	#	#	F	#	#	T	#	#	#	T	#	#

It is straightforward to confirm that Strong Kleene yields correct predictions about the sentences in (21), all of which receive a classical truth value despite containing presupposition triggers. For conjunction, if a false presupposition in a second conjunct is entailed by the first conjunct, then the first conjunct must also be false. Therefore, the sentence as a whole will be false, regardless of the value of the second conjunct (as indicated in the third row of the truth table for conjunction). For disjunction, if a false presupposition in a second disjunct is entailed by the negation of the first disjunct, then the first disjunct must be true, and so the sentence as a whole will be true, whatever the value of the second disjunct (see the second row of the truth table for disjunction). Finally, if a false presupposition of a consequent is entailed by the conditional antecedent, then the antecedent must be false as well, resulting in a true sentence overall (as shown in the third row of the truth table for conditionals).

Notice that, according to the Strong Kleene semantics in (34), the truth tables for conjunction/disjunction are symmetric along the main diagonal, meaning that switching the order of the two conjuncts/disjuncts would not affect the truth tables. Additionally, presuppositions do not always project from conditional antecedents: when the consequent is true, the sentence as a whole is true as well, even if the antecedent suffers from presupposition failure. These characteristics lead to incorrect predictions about projection in conjunctions and conditionals

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[11] Specifically: a negative sentence is classically-valued as soon as the non-negated sentence is classically-valued; a conjunction is false as soon as one of the conjuncts is false (even if the other conjunct is undefined); a disjunction is true as soon as one of the conjuncts is true (even if the other disjunct is undefined); a conditional is true if the antecedent is false or the consequent is true (regardless of the value of the other part).

(there is no consensus on whether projection from disjunctions is symmetric). For example, while *There is a bathroom and the bathroom is in a funny place* is fine, reversing the order of conjuncts leads to redundancy (cf. # *The bathroom is in a funny place and there is a bathroom*). (Similar reasoning applies to conditional sentences.) In light of this, Peters (1979) takes Strong Kleene half a step back, restoring Weak Kleene for the case when the first clause suffers from presupposition failure. This is shown in (35), where the last row differs from (34).

(35)   PETERS CONNECTIVES

ϕ	$\neg\phi$	$\phi \wedge \psi$	T	F	#	$\phi \vee \psi$	T	F	#	$\phi \rightarrow \psi$	T	F	#
T	F	T	T	F	#	T	T	T	T	T	T	F	#
F	T	F	F	F	F	F	T	F	#	F	T	T	T
#	#	#	#	#	#	#	#	#	#	#	#	#	#

   I end this subsection with the cautionary note that the basic idea behind the partiality approach—i.e., that presupposition failure leads to semantic deficiency—is not always directly reflected in our linguistic judgments. For example, while *The king of France is bald* would typically present semantic difficulty, *Last week my friend went for a drive with the king of France* rings just plain false, not infelicitous. Such contrasts have been linked to pragmatic notions like topicality or relevance (Strawson 1964; von Fintel 2004), which can seemingly alleviate our linguistic intuitions about truth.

3.4. Dynamic approach for presupposition

The asymmetric projection pattern of presuppositions in complex sentences has prompted a dynamic perspective wherein language is interpreted incrementally in a left-to-right fashion. Instead of asking whether a presupposition is SATISFIED (i.e., entailed) by the context before the sentence is uttered, presupposition is now viewed as imposing a restriction on the LOCAL CONTEXT, which includes the initial context plus any information added to it by parts of the sentence that have already been processed (Karttunen 1974; Heim 1983; 1992; Beaver 2001; see also Schlenker 2009; Barker 2022). This shift in perspective allows the interpretation rules to kill two birds with one stone, capturing both the truth and the projection patterns of sentences with presuppositions. A dynamic semantics that achieves this is presented in (36)–(37). (Below, S_p is a simple sentence carrying presupposition p,[12] A and B are sentences of any complexity, and $c + A$ stands for the update of context c (a set of possible worlds) with sentence A.)

(36) $c + S_p = c \cap [\![S]\!]$, defined only if $c \subseteq p$

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[12] It is assumed that only simple sentences carry presuppositions and also that presuppositions themselves are simple (i.e., they do not embed other presuppositions).

(37) a. $c + \neg A = c - (c + A)$
      b. $c + A \wedge B = (c + A) + B$
      c. $c + A \vee B = (c + A) \cup ((c + \neg A) + B)$
      d. $c + A \rightarrow B = (c + \neg A) \cup ((c + A) + B)$

In essence, these update rules replicate the standard truth conditions of propositional logic.[13] More remarkably, they also predict how presuppositions project in complex sentences. To see this, just pay attention to where the $+$ sign occurs on the right-hand side of each rule. Starting with (37a), updating with a negative sentence is defined just when updating with the positive counterpart is defined, meaning that presuppositions project past negation. According to (37b), updating with a conjunction is defined only if the initial context can be updated with the left conjunct and the resulting context can be updated with the right conjunct. Thus, we get projection from first conjuncts and no projection from second conjuncts if its presuppositions are entailed by the first conjunct. Similarly, (37d) predicts that in conditional sentences the presuppositions of the antecedent project while the presuppositions of the consequent are canceled if they are entailed by the antecedent. Finally, (37c) predicts projection from both disjuncts, unless a presupposition in the second disjunct is entailed by the negation of the first disjunct. In summary, a presupposition projects if it must be satisfied by the initial context; if it must be satisfied by a local context, projection may be canceled.

The satisfaction model makes the general prediction that presuppositions associated with the second part of a sentence project conditionally on the first part of the sentence. This is correct for (38), where the presupposition of the consequent is entailed by the antecedent, making the predicted inference trivially true and lacking any informative value. However, if the presupposition of the consequent is logically independent of the antecedent, as in (39), the intuition is that a stronger, unconditional inference is projected. This issue is known as the PROVISO PROBLEM (Geurts 1999; Beaver 2001; Lassiter 2012).

(38) If Mary has a husband, then her husband is happy.
      a. If Mary has a husband, then she has a husband.   (predicted)
      b. (no informative inference)   (attested)

(39) If Mary is rich, then her husband is happy.
      a. If Mary is rich, then she has a husband.   (predicted)
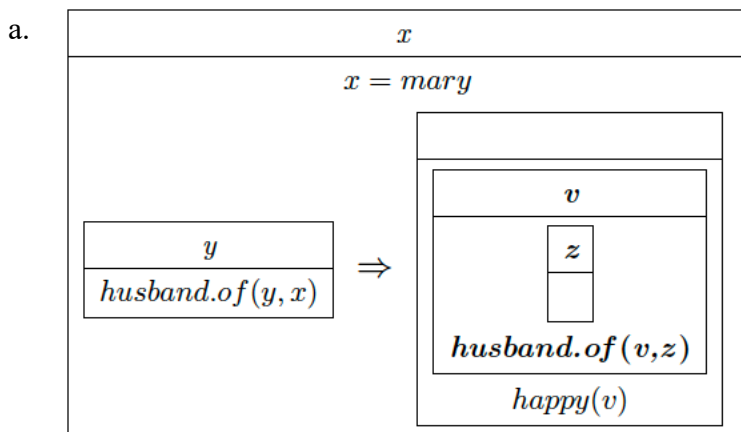   b. Mary has a husband.   (attested)

---

[13] That is, negative sentences remove from the context those worlds in which the positive sentence is true; conjunction preserves only those worlds in which both conjuncts are true; disjunction preserves those worlds in which either the first disjunct is true, or the first disjunct is false and the second disjunct is true; and finally, conditionals preserve those worlds in which the antecedent is false, or both the antecedent and the consequent are true.

The proviso problem is taken up by another dynamic account, which views presupposition as a form of anaphora (van der Sandt 1992; Geurts 1999; see also Kripke 2009). The close parallels between presupposition and anaphora are suggested by the data below, with (40) mimicking the behavior of (41).
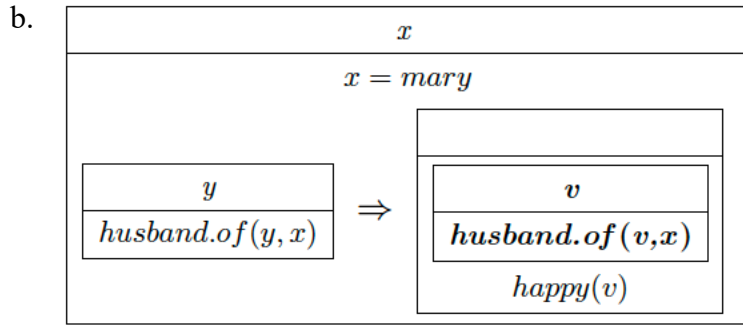
(40)   a. There was a storm. It was fierce.   (cross-sentential anaphora)
       b. If a farmer owns a donkey, then he beats it.   (donkey anaphora)

(41)   a. Fred left. Mary knows that Fred left.
       b. If Fred left, then Mary knows that Fred left.

The key claim of this account is that presupposition projection and anaphora resolution are handled by the same general mechanism. That is, presuppositions must be resolved either by binding them to a suitable antecedent (the preferred option) or by accommodating them, where "global" accommodation to the top level of the discourse is the default option (Heim 1983). Presupposition projection then results from global accommodation, while presupposition cancelation results from binding (or from "local" accommodation under an operator). As an illustration, the projection contrast in (38)–(39) is derived in (42)–(43). This derivation utilizes Discourse Representation Theory (Kamp 1981; Kamp & Reyle 1993), where a semantic representation consists of a set of discourse referents (listed on top) and a set of conditions on these referents, and presupposed content is marked in bold. Importantly, in (42) the presupposition triggered by *her husband* is bound to the conditional antecedent and generates no inference, while in (43) it is globally accommodated and generates the unconditional inference 'Mary has a husband'.
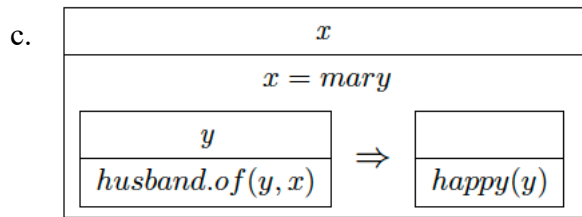
(42)   If Mary has a husband, then her husband is happy.

a.

$$
\boxed{
\begin{array}{c}
x \\
\hline
x = mary \\
\boxed{\begin{array}{c} y \\ \hline \mathbf{husband.of(y,x)} \end{array}}
\Rightarrow
\boxed{\begin{array}{c} v \\ \hline \boxed{\;z\;} \\ \mathbf{husband.of(v,z)} \\ happy(v) \end{array}}
\end{array}
}
$$

↓ (binding z to x)

b.

$$\boxed{\begin{array}{c} x \\ \hline x = mary \\[4pt] \boxed{\begin{array}{c} y \\ \hline husband.of(y,x) \end{array}} \Rightarrow \boxed{\begin{array}{c} v \\ \hline husband.of(v,x) \\ happy(v) \end{array}} \end{array}}$$

↓ (binding v to y)

c.

$$\boxed{\begin{array}{c} x \\ \hline x = mary \\[4pt] \boxed{\begin{array}{c} y \\ \hline husband.of(y,x) \end{array}} \Rightarrow \boxed{happy(y)} \end{array}}$$

(43) If Mary is rich, then her husband is happy.

a.

$$\boxed{\begin{array}{c} x \\ \hline x = mary \\[4pt] \boxed{rich(x)} \Rightarrow \boxed{\begin{array}{c} y \\ \hline \boxed{z} \\ husband.of(y,z) \\ happy(y) \end{array}} \end{array}}$$

↓ (binding z to x)

b.

$$\boxed{\begin{array}{c} x \\ \hline x = mary \\[4pt] \boxed{rich(x)} \Rightarrow \boxed{\begin{array}{c} y \\ \hline husband.of(y,x) \\ happy(y) \end{array}} \end{array}}$$

↓ (global accommodation of y)

c.
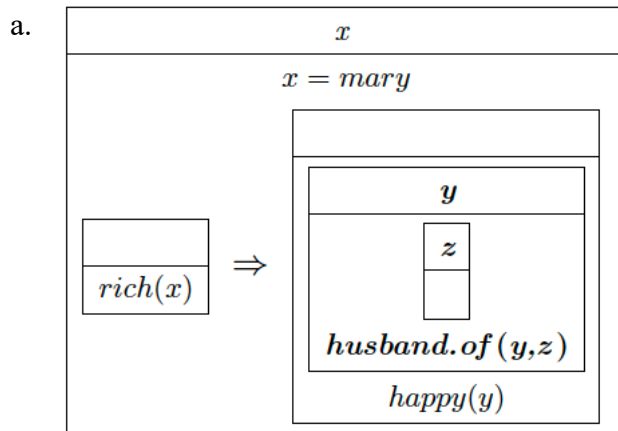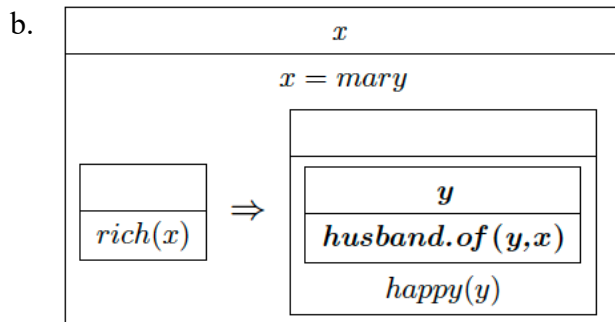
$$\begin{array}{|c|}
\hline
x\ y \\
\hline
x = mary \\
husband.of(y, x) \\
\hline
\boxed{rich(x)} \Rightarrow \boxed{happy(y)} \\
\hline
\end{array}$$
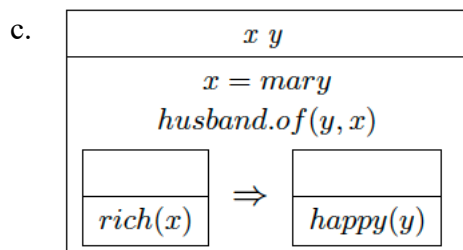
The anaphoric account to presupposition projection not only unifies presupposition and anaphora but also provides a straightforward solution to the proviso problem by paying attention to the site from which a presupposition is bound. However, this account has little to say about non-anaphoric presuppositions, such as the pre-state implications of change-of-state aspectual verbs and the veridical entailments of factive predicates (Roberts & Simons 2024). Its local context counterpart presents the opposite trade-off. While it gives rise to the proviso problem by projecting conditional inferences (but see Lassiter 2012), it does not impose an anaphoric requirement on the local context and can accommodate both anaphoric and non-anaphoric presuppositions.

3.5. Dynamic approach for CI

Unlike presuppositions, CIs do not place (satisfaction or anaphoric) preconditions on the input context, meaning that the dynamic approach to presupposition projection does not straightforwardly extend to CI projection. At the same time, dynamicity does play a crucial role in how CI interacts with the rest of the sentence. Returning to the two-dimensional approach to projection discussed in subsection 3.2, this approach is appealing because it cleanly separates asserted and projected content. Nevertheless, recalling the data in (28), this strict separation disrupts the anaphoric dependencies between the two meaning dimensions.

A way out of this predicament is a dynamic approach in which propositional content is divided into asserted and projected meanings, while the anaphoric links between them are preserved. This strategy is followed in Murray (2014) and AnderBois et al. (2015), where asserted content serves as a negotiable update proposal (Stalnaker 1978), whereas CIs enforce a non-negotiable DIRECT UPDATE on the context. To illustrate this distinction, consider the sentence with a nominal appositive in (44), following closely AnderBois et al.'s (2015) formalism.

(44)   a. Fluffy, a Siamese, curled in the corner.
        b. $\exists p \land p \subseteq c \land \exists x \land x = fluffy \land siamese_c(x) \land curl_p(x) \land \exists c \land c = p$

The semantic representation is interpreted as follow. The first four conjuncts introduce the proposal p (representing the root clause proposition) as a subset of the context set c, along with a discourse referent for the subject of the sentence. The following two conjuncts are crucial: the

appositive content updates the context (through $siamese_c(x)$), whereas the root clause content updates the proposal (through $curl_p(x)$). Finally, through the last two conjuncts (and assuming that the proposal has not been challenged), the context is reintroduced to include the new proposal. Zooming out, the key point is that appositives and root clauses contribute to two different bodies of information: the former restrict the context, the latter restrict the proposal.

This account derives projection due to the specific way in which propositional operators are handled (Stone 1997, 1999; Stone & Hardt 1999). That is, such operators bind selectively into components of their syntactic domain, thereby excluding material that is directly anchored to the context. The idea is illustrated in (45) for negation, where $\mathbf{not}_p^{p'}(\dots)$ expresses the condition that p' is the complement of p.

(45)   a. Fluffy, a Siamese, didn't curl in the corner.
        b. $\exists p \wedge p \subseteq c \wedge \exists x \wedge x = fluffy \wedge \mathbf{not}_p^{p'}(siamese_c(x) \wedge curl_{p'}(x)) \wedge \exists c \wedge c = p'$

Although the appositive occurs within the syntactic domain of negation, its contribution is coindexed with the context c, whereas negation binds predicates coindexed with p' (the worlds in which Fluffy did not curl in the corner). This configuration means that the speaker is committed to the appositive content despite the presence of negation. In other words, the appositive content projects. Moreover, since the appositive is interpreted *in situ*, any existing anaphoric links are preserved.

The direct update account views CIs as enforcing an update on the context without input from the addressee. The primary empirical motivation for this analysis is the observation that such content cannot be challenged by direct responses like *That's not true*, as shown (46). However, the issue with such responses seems to be that propositional anaphors like *that* generally have difficulty picking out such content (Snider 2017: ch.5). Other, non-anaphoric responses are quite capable of fulfilling this role, as seen in (47). This would be unexpected if CI indeed represented non-negotiable meaning.

(46)   A: Fluffy, a Siamese, curled in the corner.
        B: That's not true. (Fluffy didn't curl in the corner. / #Fluffy is not a Siamese.)

(47)   A: Fluffy, a Siamese, curled in the corner.
        B: Fluffy is not a Siamese.

Focusing on parenthetical triggers of CIs, Koev (2022: ch.3) abandons the direct update story and instead proposes to derive parenthetical projection in a more principled way. The key idea is that parenthetical expressions are ILLOCUTIONARILY INDEPENDENT: parentheticals are headed by (covert) force operators that are anchored to the context and cannot be bound by external propositional operators, resulting in projective behavior. The illocutionary independence of parentheticals is motivated by "hybrid" sentences, as in (48)–(49), where the root clause and

the parenthetical expression (an appositive, a question tag, etc.) differ in illocutionary force (Levinson 1983: §5.4).

(48)　Does John, who could never learn elementary calculus, really intend to do a PhD in mathematics?

(49)　Wittgenstein was an Oxford philosopher, wasn't he?

Under the illocutionary independence account, a negative sentence with an appositive is analyzed as in (50).

(50)　a. Jill, who is a linguist, isn't rich.
　　　b. $\mathbf{decl}_c^p(\mathbf{not}_p^q(\exists x \wedge x = jill \wedge \mathbf{decl}_c^r(linguist_r(x)) \wedge rich_q(x)))$

The semantic representation above contains two declarative operators: one heading the root clause and another heading the parenthetical expression, both anchored to the context. While the root clause operator introduces a propositional referent which binds the negation (which in turn binds into the lexical predicate *rich*), the parenthetical operator introduces a propositional referent which binds into the lexical predicate *linguist*, thereby shielding the parenthetical content from the effects of negation. As a result, the speaker is committed to two propositions: the proposition that Jill is not rich, and (crucially) the proposition that Jill is a linguist. Thus, the parenthetical content is predicted to project without being forced upon the context.

Note also that the two illocutionary operators in (50) need not be identical. While both are declarative in force, we can boil into them different discourse requirements, e.g., regarding the relevance of the content they embed. This allows us to capture the discourse effects that are at the heart of the QUD approach to projection, presented in the following subsection.

3.6. QUD approach

The approaches discussed so far have been syntactic or semantic, and—with the exception of the two-dimensional approach—only apply to presupposition or to CI. A more general, pragmatic approach is based on the discourse status of projective content (Simons et al. 2010; Beaver et al. 2017; Tonhauser et al. 2018). Specifically, this approach seeks to derive projection from the fact that projective meaning is usually not at-issue, i.e., not relevant to the QUESTION UNDER DISCUSSION (QUD; Roberts 2012). The cornerstone of this approach is the hypothesis that there is a systematic overlap between projection and lack of at-issueness, as stated in (51).

(51)　PROJECTION PRINCIPLE (cf. Simons et al. 2010: 309)
　　　An implication projects iff it is not at-issue relative to the current QUD.

The Projection Principle is motivated by the observation that projected meaning cannot naturally answer explicit questions even when containing the necessary information. Examples (52) and (53) illustrate this for the cases of presupposition and CI, respectively.

(52)   Q: Does France have a king?
        A: #The king of France is bald.

(53)   Q: Is Edna a fearless leader?
        A: #Edna, a fearless leader, started the descent.

Moreover, given the close connection between (presentational/new information) focus and the current QUD (Rooth 1992; Schwarzschild 1999; Beaver & Clark 2008: ch.2), projection may shift depending on prosodic prominence. This is illustrated in (54).

(54)   a. QUD: *Will the T.A. discover that your work is plagiarized?*
           If the T.A. disCOVers that your work is plagiarized, I will be forced to notify the Dean.
           ≫ Your work is plagiarized.

        b. QUD: *Is your work plagiarized?*
           If the T.A. discovers that your work is PLAgiarized, I will be forced to notify the Dean.
           (no factive inference)

Due to its generality, the QUD approach has the potential to unite the diverse class of projective meanings under a single property, i.e., at-issueness. However, there are both empirical and theoretical concerns about the Projection Principle. Empirically, the main concern is the bi-conditional form of this principle, which predicts a perfect correlation between projection and not-at-issueness. Specifically, looking at the right-to-left direction, embedded complements under non-factive predicates do not project even when not at-issue. One example is cited in (55), where the complement is not relevant to the QUD (it describes a state, while the preceding question describes an event), and yet this complement fails to project.

(55)   Q: What happened after the satellite started sending bogus data?
        A: The space agency claimed that there was water on Jupiter.

As for the left-to-right direction of the Projection Principle, there are apparent examples where content seems to be at-issue but still projects, as in (56). Nonetheless, there is a strong tendency for projective content to maintain its not-at-issue status.

(56)   Q: Why is Jon not is his office?
        A: He might be talking with the director, who fired him on a whim.

Perhaps because of data like these, Beaver et al. (2017) and Tonhauser et al. (2018) restrict the application of the Projection Principle to "projective" content, i.e., to content that has the *potential* to project in the sense that it need not take scope under embedding operators. However, this move begs the question of what makes such content projective in the first place. The most plausible answer would be that this is due to some form of conventional marking, yet this answer rubs against the pragmatic grain of the QUD approach.

A second concern is that the QUD approach proposes no theoretical mechanism that explains why projectivity and at-issueness are so tightly linked. Such a mechanism would presumably integrate compositional semantics and discourse structure. However, without a concrete proposal on the table, it is difficult to evaluate the empirical predictions with the necessary level of precision.

4. Projection variability

Projection has traditionally been regarded as an absolute category, meaning that an expression either always triggers a projective inference or it never does. However, this obscures the fact that the projective inferences triggered by some expressions are easier to defeat than those triggered by other expressions. This fact naturally leads to the idea that projection is variable, or comes in degrees.

Within the realm of presupposition, the literature has distinguished between HARD and SOFT triggers, with the former generating lexical presuppositions that are difficult to cancel and the latter producing less stable inferences. The mechanism behind soft triggering has been claimed to involve contextual alternatives to lexical triggers (Abusch 2010; Romoli 2015) or to rely on information that is semantically, cognitively or ontologically necessary and yet inert (Abrusán 2011; Schlenker 2021; Roberts & Simons 2024). A relevant empirical contrast is provided in (57)–(58). Here, the inference from *win* to *participate* melts away when it clashes with contextual information, whereas the existential inference triggered by a cleft construction persists and results in infelicity.

(57)   I have no idea whether John ended up participating in the Road Race yesterday. But if he won it, then he has more victories than anyone else in history.

(58)   I have no idea whether anyone read that letter. ??But if it is John who read it, let's ask him to be discreet about the content.

Extending binary contrasts like these, recent experimental work has compared the strength of projection across different triggers, uncovering fine-grained differences in projection variability (Xue & Onea 2011; Smith & Hall 2013; Tonhauser et al. 2018; De Marneffe et al. 2019; Degen & Tonhauser 2022). Several important lessons emerge from this work. The main

lesson is that, unsurprisingly, the triggering expression or construction plays a key role in predicting projection strength. For example, implications launched by appositives project more robustly than implications launched by factives, while there is considerable variability within the latter class. Additionally, there are several grammatical and pragmatic factors that may affect projection. Grammatical factors include the temporal marking on a factive predicate, the person feature on a factive predicate's subject, the modal flavor of the entailment-canceling operator, and others. As for pragmatic factors, the degree to which content projects has been shown to be positively correlated with the degree to which said content is not at-issue, arguing for a gradient version of the Projection Principle in (51).

I close this section with a cautionary note. When discussing gradient projection, we should be aware that this concept can be understood in two non-equivalent ways. The classical interpretation treats projection as an all-or-nothing property, with gradient projection measuring the proportion of instances in which a given trigger fully commits the speaker to the relevant inference. Another, more liberal interpretation of the same concept is that the speaker may be committed to the inference generated by a given trigger to varying degrees. To see why these two interpretations are not equivalent, consider the behavior of two hypothetical triggers, A and B with respective projective inferences p_A and p_B, when occurring under entailment-canceling operators. Imagine that trigger A fully commits the speaker to p_A half of the time and otherwise it fails to convey any commitment, whereas trigger B consistently commits the speaker to p_B to some high yet non-maximal degree. Under the classical interpretation of projection variability, A would be considered (weakly) projective, whereas B would not count as projective at all, since it never leads to full speaker commitment. Conversely, under the more liberal interpretation, B would actually count as being more projective than A, as B's overall projection score will exceed that of A. It is an open empirical question which of these two interpretations better captures our intuitive idea of gradient projection.

5. Conclusion

Meaning projection is the ability of certain implications to survive embedding under entailment-canceling operators without their lexical triggers being subjected to some form of syntactic manipulation. The range of projective triggers is very diverse, and the engendered inferences chiefly fall into the categories of presupposition or conventional implicature. Various theoretical approaches have been developed to explain projection. While some of these approaches aim at capturing projection as a cohesive phenomenon, a comprehensive theory remains elusive at the current stage of the research.

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