The projection problem of presuppositions

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1 Presuppositional vs. truth-conditional meaning components

1.1 Truth-conditional meaning

Standardly, the literal meaning of a declarative sentence are its truth-conditions. (1a) is true in a world w of context c iff John smokes in w. (2a) is true in w iff John does not smoke in w.

(1) a. John smokes.
b. $[\![\textbf{John smokes}]\!]^w$ $= [\![\textbf{smokes}]\!]^w([\![\textbf{John}]\!]^w)$ (FA)
$= [\lambda x_e \,.\, x \text{ smokes in } w](\text{John})$ (lexicon)
$= 1$ iff John smokes in w

(2) a. John does *not* smoke.
b. not [John smokes]
c. $[\![\textbf{not [John smokes]}]\!]^w$ $= [\![\textbf{not}]\!]^w([\![\textbf{John smokes}]\!]^w)$ (FA)
$= [\lambda p_t \,.\, p = 0]([\![\textbf{John smokes}]\!]^w)$ (lexicon)
$= 1$ iff $[\![\textbf{John smokes}]\!]^w) = 0$ (1b)
$= 1$ iff John does not smoke in w

1.2 Presuppositional meaning

1.2.1 Pressuppositions vs. truth-conditions

In addition, a sentence can have non-truth-conditional content such as presuppositions. (3a) presupposes that John used to smoke and is true iff John stopped smoking.

(3) John stopped smoking.

In other words, (3) has the same (or very similar) truth-conditions as (3) but its presupposition is different.

How can we sure about this? That is, why does (3) not simply have the truth-conditions in (4) without any presupposition at all?

(4) **A hypothetical non-presuppositional analysis of (3)**
$[\![\textbf{John stopped smoking}]\!]^w = 1$ iff John used to smoke in w at some point and John does not smoke in w now

1.2.2 Two reasons for treating presuppositions as different from truth-conditional content

Entailment-cancelling environments Presuppositions are not affected by entailment-cancelling environments, but truth-conditions are (e.g. Chierchia and McConnell-Ginet 2000). All the following examples lose the inference that John does not smoke anymore. For negation, for instance, this is as expected given the derivation in (2c). The inference that John used to smoke, however, remains for all the examples, i.e., is not affected by embdding.

(5) John stopped smoking. $\leadsto$ *John does not smoke anymore*
$\leadsto$ *John used to smoke*

(6) John did *not* stop smoking. $\not\leadsto$ *John does not smoke anymore*
$\leadsto$ *John used to smoke*

(7) *Did* John stop smoking? $\not\leadsto$ *John does not smoke anymore*
$\leadsto$ *John used to smoke*

(8) *If* John stopped smoking, he has cancer. $\not\leadsto$ *John does not smoke anymore*
$\leadsto$ *John used to smoke*

"Old" vs. "new" information Presuppositions are "old" information, truth-conditional content is "new" information. In particular, presuppositions correspond to mutually shared beliefs between the speaker and the addressee (see Stalnaker 1974, more on that later), whereas truth-conditional content is ideally novel information for the addressee. A cooperative speaker should not assert known things (Grice 1975). For that reason, presuppositions, but not truth-conditional information can be targeted by the *Hey, wait a minute test* (von Fintel 2004):

(9) A: John stopped smoking.
B: Hey, wait a minute. I didn't know that John used to smoke.

(10) A: John stopped smoking.
B: #Hey, wait a minute. I didn't know that does not smoke anymore.

1.2.3 Examples of presupposition triggers

Presuppositions are contributed by lexical items, so-called presupposition triggers.

(11) **Aspectual verbs**
a. John *started* smoking. $\leadsto$ *John didn't use to smoke*
b. John didn't *start* smoking. $\leadsto$ *John didn't use to smoke*

(12) **Aspectual adverbs**
a. John *still* smokes. $\leadsto$ *John used to smoke*
b. Does John *still* smoke? $\leadsto$ *John used to smoke*

(13) **Definite descriptions and possessives**
a. John likes *his sister*. $\leadsto$ *John has a sister*
b. John doesn't like *his sister*. $\leadsto$ *John has a sister*

(14) **Factive predicates**
a. John *regrets* having told a lie. $\leadsto$ *John told a lie*
b. John doesn't *regret* having told a lie. $\leadsto$ *John told a lie*

(15) **Focus operators**

a. JOHN smokes, *too*. $\rightsquigarrow$ *Someone other than John smokes*
b. Does JOHN smoke, *too*? $\rightsquigarrow$ *Someone other than John smokes*

1.2.4 How to define presuppositions?

Can we be a bit more precise about what type of meaning component presuppositions actually are? There is a number of definitions, but the following two are particularly wide-spread (Heim 1990):

Presuppositions as Conventional implicatures Presuppositions are one particular informational component, alongside truth-conditional content and conversational implicatures (Gazdar 1979, Karttunen and Peters 1979, Sudo 2012). According to Karttunen and Peters (1979), for instance, each node in a tree has a truth-conditional value and a presuppositional one. They do not necessarily interact.

To get an idea let us assume that each expression has two semantics values, an ordinary value $[\![\ ]\!]^{o,w}$ and a presuppositional value $[\![\ ]\!]^{p,w}$. These are computed in parallel according to the familiar rules of composition. What is crucial is that logical operators like negation as in (16d) have a presuppositional value that does not affect the presuppositional meaning, for instance, by being defined as an identity function on propositions/truth-values. **Note: this is not what Karttunen and Peters (1979) actually propose. We return to their system below**.

(16) a. (i) $[\![\textbf{smoke}]\!]^{o,w} = \lambda x_e\ .\ x$ smokes in w
(ii) $[\![\textbf{smoke}]\!]^{p,w} = [\![\textbf{smoke}]\!]^{o,w}$
b. (i) $[\![\textbf{stop}]\!]^{o,w} = \lambda f_{\langle e,t\rangle}.\lambda x_e\ .$ at present $f(x) = 0$
(ii) $[\![\textbf{stop}]\!]^{p,w} = \lambda f_{\langle e,t\rangle}.\lambda x_e\ .$ in the past $f(x) = 1$
c. (i) $[\![\textbf{John}]\!]^{o,w}$ = John
(ii) $[\![\textbf{John}]\!]^{p,w} = [\![\textbf{John}]\!]^{o,w}$
d. (i) $[\![\textbf{not}]\!]^{o,w} = \lambda p_t\ .\ p = 0$
(ii) $[\![\textbf{not}]\!]^{p,w} = \lambda p_t\ .\ p$

(17) $[\![\textbf{John didn't stop smoking}]\!]^{o,w} = [\![\textbf{not}]\!]^{o,w}([\![\textbf{stop}]\!]^{o,w}([\![\textbf{smoke}]\!]^{o,w})(\text{John}))$
$= [\lambda p\ .\ p = 0]([\lambda f\ .\ \lambda x_e\ .$ at present $f(x) = 0](\lambda y\ .\ y$ smokes in $w)(\text{John}))$
$= [\lambda p\ .\ p = 0]($at present $[\lambda y\ .\ y$ smokes in $w](\text{John}) = 0)$
$= [\lambda p\ .\ p = 0]($at present John doesn't smoke in $w)$
$= 1$ iff at present John smokes in w

(18) $[\![\textbf{John didn't stop smoking}]\!]^{p,w} = [\![\textbf{not}]\!]^{p,w}([\![\textbf{stop}]\!]^{p,w}([\![\textbf{smoke}]\!]^{p,w})(\text{John}))$
$= [\lambda p\ .\ p]([\lambda f\ .\ \lambda x_e\ .$ in the past $f(x) = 1](\lambda y\ .\ y$ smokes in $w)(\text{John}))$
$= [\lambda p\ .\ p]($in the past $[\lambda y\ .\ y$ smokes in $w](\text{John}) = 1)$
$= [\lambda p\ .\ p]($in the past John smoked in $w)$
$= 1$ iff in the past John smoked in w

According to this view, both the truth-conditional and presuppositional components are independent but actually semantically contentful, i.e., provide information.

Presuppositions as admittance conditions The presuppositions of a sentence S are those propositions that the common ground of any context c (or rather its context set) must entail in order for S to be felicitous in c (Stalnaker 1973, 1974, 1978, Karttunen 1974, Heim 1983). We say that c admits S iff its common ground entails all of S's presuppositions.

(19) a. Common ground of $c =: \{p :$ for each participant x of c, x believes $p\}$

b. Context set of $c =: \cap\{p : p \in \text{common ground of } c\}$
(Stalnaker 1978)

(20) a. In all worlds in the common ground of *c* John smoked at some time in the past, i.e., the context entails that John smoked at some time in the past.
b. *c* admits **John didn't stop smoking**.
c. **John didn't stop smoking** adds via its truth-conditions the information to *c* that John still smokes.

The possibility of accommodation What happens in a context whose common ground does not entail a presupposition of a sentence uttered? Assume a context *c* whose common ground does not entail John used to smoke at some time in the past.

- According to the conventional implicature view that does not change anything. When presented with *John didn't stop smoking* we add both the information that John used to smoke and the one that he does not do so anymore to the common ground.
- According to the addmittance condition view, *c* does not admit *John didn't stop smoking*. Its common ground does not entail the presupposition.

Is the latter a realistic picture? Given the relative unnaturalness of B's reply to A in (21) apparently not. (Of course, there might be instances where B's reply is not that strange after all. Note that this fact in itself shows that the HWAM-test is rather corse and should not be relied on too much).

(21) *Context: B has no idea whether A has a sister or not.*
A: When I get home, *my sister* will pick me up from the airport.
B: #Hey wait a minute, you never told me you have a sister.

Gazdar (1979) takes cases like (21) to suggest that the conventional implicature view is correct.

However, the addmittance condition view is still defendable. Following Lewis (1979) utterance of a sentence whose presupposition *P* is not entailed by the common ground will simply add the proposition corresponding to *P* to the common ground. This is called accommodation.

Strong triggers So can we distinguish between the two views at all? Kripke (2009) points out that the presuppositions of anaphoric triggers like *too* are difficult to accommodate accounting for the unnaturalness of (22). This would make sense under an addmittance-based view if the presupposition of *too* requires that some particular individual different from John and salient in the context went to Harvard. Which proposition should then be accommodated in (22)? There are too many candidates.

(22) *Context: We are talking about John. No other person who went to Harvard has been mentioned.*
#John went to Havard, too.

But possibly something else goes wrong in (22). Maybe the anaphoric component of *too* is not satisfied—that is, it is not the presupposition that cannot be accommodated but rather *too* has an overt-antecedent requirement, which is not met in (22) (Chemla and Schlenker 2012).

Thus strong triggers do not seem to distinguish between the conventional implicature and addmittance-based views.

2 The projection problem

2.1 Stating the problem

Varying presuppositions in conditionals While both (23a), (23b) and (23c) have the inference that John used to smoke, (23d) does not have that inference. If we take the presence of the inference to mean that the sentence presupposes that John used to smoke, then absence of the inference is naturally thought of as indicating the absence of that presupposition. We say that the antecedent in (23d) filters the presupposition of the consequent. Why do presuppositions sometimes get inherited by a complex sentence and why sometimes not, i.e., filtered?

(23) a. John *stopped* smoking. $\rightsquigarrow$ *John used to smoke*
b. If John *stopped* smoking, he has cancer. $\rightsquigarrow$ *John used to smoke*
c. If John got married, he *stopped* smoking. $\rightsquigarrow$ *John used to smoke*
d. If John ever smoked, he *stopped*. $\not\rightsquigarrow$ *John used to smoke*

This pattern is stable across presupposition triggers:

(24) a. John will invite *the king of France*. $\rightsquigarrow$ *France has a king*
b. If John invites *the king of France*, we'll have fun. $\rightsquigarrow$ *France has a king*
c. If Mary wants a king to be present, John will invite *the king of France*. $\rightsquigarrow$ *France has a king*
d. If France is a monarchy, John will invite *the king of France*. $\not\rightsquigarrow$ *France has a king*

The patterns seen above establish the so-called projection problem of presuppositions.

(25) **The projection problem of presuppositions**
How can the presuppositions of a complex sentence *S* be predicted in a compositionally transparent way from the presuppositions of the parts of *S*?

Projection from conjunctions All of (26a) to (26c) suggest that John used to smoke. In (26a) and (26b) the presupposition of *stop* is clearly inherited by the complex sentence. In (26c) the presupposition is entailed by the truth-conditional content. The sentence does not seem to place a requirement on the context. As such we might say that it does not presuppose that John used to smoke. In (26d), the presupposition seems to project. Thereby the second conjunct becomes entailed by the first. It is redundant, which is why the sentence is odd.

(26) a. John *stopped* smoking, **and** he has cancer. $\rightsquigarrow$ *John used to smoke*
b. John has cancer, **and** he *stopped* smoking. $\rightsquigarrow$ *John used to smoke*
c. John used to smoke, **and** he *stopped*. $\not\rightsquigarrow$ *John used to smoke*
d. #John *stopped* smoking, **and** he used to smoke. $\rightsquigarrow$ *John used to smoke*

Projection from disjunctions Similarly to conjunction both of (27a) and (27b) presuppose that John used to smoke. In (27c) and (27d) that presupposition is filtered and thus not inherited by the complex disjunction.

(27) a. Either John *stopped* smoking, **or** he doesn't have cancer. $\rightsquigarrow$ *John used to smoke*
b. Either John doesn't have cancer, **or** he *stopped* smoking. $\rightsquigarrow$ *John used to smoke*
c. Either John never smoked, **or** he *stopped*. $\not\rightsquigarrow$ *John used to smoke*
d. Either John *stopped* smoking, **or** he never smoked. $\not\rightsquigarrow$ *John used to smoke*

Conjunction and disjunction give rise to another puzzle:

(28) **Incremental vs symmetric filtering**
Is presupposition filtering incremental as suggested by conjunction or symmetric as suggested by disjunction?

Projection from quantifier scopes How should we even begin to state the presupposition of a quantificational example such as (29)? As the LF in (30) makes clear the trace corresponding to the quantificational NP is abstracted over—that is, t_1 is not an individual about which one could presuppose that he/she used to smoke (Karttunen 1971, Heim 1983). Clearly, however, the individuals in $\{x : [\![\textbf{these ten students}]\!]^w(x) = 1\}$ must have smoked for (29) to be felicitous, i.e., (29) seems to presuppose that everyone of the ten students used to smoke. How does this presupposition come about?

(29) **Everyone** of these ten students *stopped* smoking.

(30) everyone of these ten students 1[t_1 stopped smoking]

Moreover, there appears to be variation in the presupposition projected from quantifier scopes according to the quantifier/indefinite used:

(31) a. **One** of these ten students *stopped* smoking. ⇝ *Some student used to smoke*
b. **Everyone** of these ten students *stopped* smoking. ⇝ *Every student used to smoke*
c. **None** of these ten students *stopped* smoking. ⇝ *Every student used to smoke*

3 The plugs, holds, and filters approach

Working in the conventional implicature framework, Karttunen (1973), Karttunen and Peters (1979) argue that all one needs to do to account for the projection patterns observed is to specify the presupposition inheritance properties of the logical connectives, quantifiers, etc. The latter suggest that each expression has three semantic values: an ordinary value $[\![\ ]\!]^o$, a presupposition value $[\![\ ]\!]^p$, and a inheritance value $[\![\ ]\!]^h$. Only functors have a non-trivial inheritance value. It specifies whether the functor is a hole (projects presuppositions), a plug (blocks presuppositions from projecting) or a filter (projects a modified presupposition) for the presuppositions of its argument.

3.1 Negation as hole or plug for presuppositions

(32) a. $[\![\textbf{smokes}]\!]^{o,w} = \lambda x_e \,.\, x$ smokes in w
b. $[\![\textbf{smokes}]\!]^{p,w} = \lambda x_e \,.\, \top$
c. $\forall\alpha : [\![\alpha]\!]^{o,w} \in Dom([\![\textbf{smoke}]\!]^{o,w}) : [\![\textbf{smoke}]\!]^h(\alpha) = [\![\alpha]\!]^{p,w}$

(33) a. $[\![\textbf{John}]\!]^{o,w}$ = John
b. $[\![\textbf{John}]\!]^{p,w} = \top$
c. $[\![\textbf{John}]\!]^h$ = undefined

(34) a. $[\![\textbf{stop}\ ]\!]^{o,w} = \lambda f_{\langle e,t\rangle}.\lambda x_e$. at present $f(x) = 0$
b. $[\![\textbf{stop}]\!]^{p,w} = \lambda f_{\langle e,t\rangle}.\lambda x_e$. in the past $f(x) = 1$
c. $\forall\alpha : [\![\alpha]\!]^{o,w} \in Dom([\![\textbf{stop}]\!]^{o,w}) : [\![\textbf{stop}]\!]^h(\alpha) = [\![\alpha]\!]^{p,w}$

(35) **Functional application à la Karttunen and Peters (1979)**
If α is a node consisting of β and γ where $[\![\beta]\!]^{o,w} \in Dom([\![\gamma]\!]^{o,w})$,
a. $[\![\alpha]\!]^{o,w} = [\![\gamma]\!]^{o,w}([\![\beta]\!]^{o,w})$.
b. (i) $[\![\alpha]\!]^{p,w} = [\![\gamma]\!]^{p,w}([\![\beta]\!]^{o,w}) \wedge [\![\gamma]\!]^h([\![\beta]\!]^{p,w})$,
if $[\![\gamma]\!]^{p,w}([\![\beta]\!]^{o,w}, [\![\gamma]\!]^h([\![\beta]\!]^{p,w}) \in D_t$.

(ii) $[\![\alpha]\!]^{p,w} = \lambda\chi_1 \ldots \lambda\chi_n \,.\, [[\![\gamma]\!]^{p,w}([\![\beta]\!]^{o,w})(\chi_1)\ldots(\chi_n) \wedge$
$[\lambda\chi'_1 \ldots \lambda\chi'_n[\![\gamma]\!]^{h}([\![\beta]\!]^{p,w})](\chi_1)(\chi_n)],$
if $[\![\gamma]\!]^{p,w}([\![\beta]\!]^{o,w} \in D_{\langle\tau,t\rangle}, [\![\gamma]\!]^{h}([\![\beta]\!]^{p,w}) \in D_t$.

(iii) $[\![\alpha]\!]^{p,w} = \lambda\chi_1 \ldots \lambda\chi_n \,.\, [\lambda\chi'_1 \ldots \lambda\chi'_n[[\![\gamma]\!]^{p,w}([\![\beta]\!]^{o,w})](\chi_1)\ldots(\chi_n) \wedge$
$[\![\gamma]\!]^{h}([\![\beta]\!]^{p,w})(\chi_1)(\chi_n)],$
if $[\![\gamma]\!]^{p,w}([\![\beta]\!]^{o,w} \in D_t, [\![\gamma]\!]^{h}([\![\beta]\!]^{p,w}) \in D_{\langle\tau,t\rangle}$.

(iv) $[\![\alpha]\!]^{p,w} = \lambda\chi_1 \ldots \lambda\chi_n \,.\, [\lambda\chi'_1 \ldots \lambda\chi'_n[[\![\gamma]\!]^{p,w}([\![\beta]\!]^{o,w})](\chi_1)\ldots(\chi_n) \wedge$
$[\lambda\chi'_1 \ldots \lambda\chi'_n[[\![\gamma]\!]^{h}([\![\beta]\!]^{p,w})](\chi_1)(\chi_n)],$
if $[\![\gamma]\!]^{p,w}([\![\beta]\!]^{o,w}, [\![\gamma]\!]^{h}([\![\beta]\!]^{p,w}) \in D_{\langle\tau,t\rangle}$.

c. (i) $\forall\delta : [\![\delta]\!]^{o,w} \in Dom([\![\gamma]\!]^{o,w}([\![\beta]\!]^{o,w})) : [\![\alpha]\!]^{h}(\delta) = [\![\delta]\!]^{p,w}$,
if $[\![\alpha]\!]^{o,w} \in D_{\langle\tau,t\rangle}$.

(ii) $[\![\alpha]\!]^{h} = \top$, if $[\![\alpha]\!]^{o,w} \in D_t$.

This predicts the presupposition that John used to smoke for (36).

(36) a. John stopped smoking.
b. $[_S$ John $[_{VP}$ stopped smoking]]

(37) a. $[\![\mathbf{VP}]\!]^{p,w} = \lambda x \,.\, [[\![\mathbf{stopped}]\!]^{p,w}([\![\mathbf{smoking}]\!]^{o,w})(x) \wedge$
$[\lambda y.[\![\mathbf{stopped}]\!]^{h}([\![\mathbf{smoking}]\!]^{p,w})](x)]$ (FAbii)
$= \lambda x$. in the past x smoked in $w \wedge [\lambda y.\top](x)$ (lexicon)
$= \lambda x$. in the past x smoked in w
b. $\forall\alpha : [\![\alpha]\!]^{o,w} \in Dom([\![\mathbf{stopped}]\!]^{o,w}([\![\mathbf{smoking}]\!]^{o,w}))$:
$[\![\mathbf{VP}]\!]^{h}(\alpha) = [\![\alpha]\!]^{p,w}$ (FAci)

(38) a. $[\![\mathbf{S}]\!]^{p,w} = [\![\mathbf{VP}]\!]^{p,w}([\![\mathbf{John}]\!]^{o,w}) \wedge [\![\mathbf{VP}]\!]^{h}([\![\mathbf{John}]\!]^{p,w})$ (FAbi)
$= [\lambda x$. in the past x smoked in w](John) $\wedge \top$ (lexicon)
$= [\lambda x$. in the past x smoked in w](John)
b. $\forall\alpha : [\![\alpha]\!]^{o,w} \in Dom([\![\mathbf{VP}]\!]^{o,w}([\![\mathbf{John}]\!]^{o,w})) : [\![\mathbf{S}]\!]^{h}(\alpha) = [\![\alpha]\!]^{p,w}$ (FAci)

In (39) negation is defined as a hole for presuppositions, i.e., it lets the presupposition project. Thus we get for (40a) also the presupposition that John used to smoke

(39) a. John didn't stop smoking.
b. $[_{S'}$ not $[_S$ John $[_{VP}$ stopped smoking]]]

(40) a. $[\![\mathbf{not}]\!]^{o,w} = \lambda p_t \,.\, p = 0$
b. $[\![\mathbf{not}]\!]^{p,w} = \lambda p_t \,.\, \top$
c. $\forall\alpha : [\![\alpha]\!]^{o,w} \in Dom([\![\mathbf{not}]\!]^{o,w}) : [\![\mathbf{not}]\!]^{h}(\alpha) = [\![\alpha]\!]^{p,w}$

(41) $[\![\mathbf{S'}]\!]^{p,w} = [\![\mathbf{not}]\!]^{p,w}([\![\mathbf{S}]\!]^{o,w}) \wedge [\![\mathbf{not}]\!]^{h}([\![\mathbf{S}]\!]^{p,w})$ (FAbi)
$= \top \wedge [\lambda x_e$. in the past x smoked in w](John) (lexicon)
$= [\lambda x_e$. in the past x smoked in w](John)

(42) $\forall\alpha : [\![\alpha]\!]^{o,w} \in Dom([\![\mathbf{not}]\!]^{o,w}([\![\mathbf{John\ VP}]\!]^{o,w}))$:
$[\![\mathbf{not\ [John\ VP]}]\!]^{h} = [\![\alpha]\!]^{p,w}$ (FAci)

But we could have also defined negation as a plug for presupposition, i.e., as not letting the presuppositions project. This could be, for instance, done by defining the heritage value of negation as returning the tautology when applied to an argument, i.e., the presupposition that is always true.

(43) a. $[\![\mathbf{not}_2]\!]^{o,w} = \lambda p_t \,.\, p = 0$
b. $[\![\mathbf{not}_2]\!]^{p,w} = \lambda p_t \,.\, \top$
c. $\forall\alpha : [\![\alpha]\!]^{o,w} \in Dom([\![\mathbf{not}]\!]^{o,w}) : [\![\mathbf{not}]\!]^{h}(\alpha) = \top$

(44) $[\![\textbf{not}_2\ \textbf{S}]\!]^{p,w} = [\![\textbf{not}_2]\!]^{p,w}([\![\textbf{S}]\!]^{o,w}) \wedge [\![\textbf{not}_2]\!]^{h}([\![\textbf{S}]\!]^{p,w})$ (FAbi)
$= \top \wedge \top$ (lexicon)

In fact, Karttunen and Peters (1979) argue that such a second negation is needed to deal with cases of so-called "presupposition cancellation" under negation as in (45). Projecting the presupposition that John used to smoke as regular negation would do would lead to a contradiction.

(45) John didn't stop smoking, because he never smoked in the first place.

3.2 Filtering with binary connectives

Conjunction as an example In order to predict the filtering of presuppositions in the second conjunct of (46c), the inheritance value of conjunction must be defined as a filter, i.e., as letting a modified presupposition project.

(46)
a. John *stopped* smoking, **and** he has cancer. ⇝ *John used to smoke*
b. John has cancer, **and** he *stopped* smoking. ⇝ *John used to smoke*
c. John used to smoke, **and** he *stopped*. $\not\rightsquigarrow$ *John used to smoke*
d. #John *stopped* smoking, **and** he used to smoke. ⇝ *John used to smoke*

(47)
a. $[\![\textbf{and}]\!]^{o,w} = \lambda p_t.\lambda q_t\ .\ p = q = 1$
b. $[\![\textbf{and}]\!]^{p,w} = \lambda p_t.\lambda q_t\ .\ \top$
c. $\forall\alpha : [\![\alpha]\!]^{o,w} \in Dom([\![\textbf{and}]\!]^{w,o}).\forall p : p \in Dom([\![\textbf{and}]\!]^{o,w}([\![\alpha]\!]^{o,w}) :$
$[\![\textbf{and}]\!]^{h}(\alpha) = p \rightarrow [\![\alpha]\!]^{p,w}$

We thus predict as a presupposition for (48a) that John used to smoke:

(48)
a. John *stopped* smoking, **and** he has cancer.
b. $[_{\text{ConjP}}\ [_{\text{S}}$ John $[_{\text{VP}}$ stopped smoking $]]\ [_{\text{Conj}'}$ and $[_{\text{S}''}$ he has cancer $]]]$

(49)
a. $[\![\textbf{Conj}']\!]^{p,w} = \lambda p\ .\ [[\![\textbf{and}]\!]^{p,w}([\![\textbf{S}'']\!]^{o,w}(p) \wedge [\lambda p'.[\![\textbf{and}]\!]^{h}([\![\textbf{S}'']\!]^{p,w}](p)]$ (FAbii)
$= \lambda p\ .\ [[\lambda p'.\lambda q'.\top]([\![\textbf{S}'']\!]^{o,w})(p) \wedge [\lambda p'.p' \rightarrow \top](p)]$ (lexicon,FAbi)
$= \lambda p\ .\ \top \wedge (p \rightarrow \top)$
$= \lambda p\ .\ p \rightarrow \top$
$= \lambda p\ .\ \top$
b. $\forall\alpha : [\![\alpha]\!]^{o,w} \in Dom([\![\textbf{and}]\!]^{o,w}([\![\textbf{he has cancer}]\!]^{o,w})) :$
$[\![\textbf{Conj}']\!]^{h}(\alpha) = [\![\alpha]\!]^{p,w}$ (FAci)

(50) $[\![\textbf{ConjP}]\!]^{p,w} = [\![\textbf{Conj}']\!]^{p,w}([\![\textbf{S}]\!]^{o,w} \wedge [\![\textbf{Conj}']\!]^{h}([\![\textbf{S}]\!]^{p,w})$ (FAbi)
$= [\lambda p\ .\ \top]([\![\textbf{S}]\!]^{o,w}) \wedge [\lambda x\ .$ in the past x smoked in $w](\text{John})$
$= [\lambda x\ .$ in the past x smoked in $w](\text{John})$

The same presupposition is predicted for (51). We do not know why it is degraded though. Potentially, we could have a theory of redundancy on top of the projection theory that were incremental.

(51) #John *stopped* smoking, **and** he used to smoke.

For (52a) we predict a conditional presupposition saying that if John has cancer, he used to smoke. This presupposition strikes one as too weak in light of the perceived inference.

(52)
a. John has cancer, **and** he *stopped* smoking.
b. $[_{\text{ConjP}}\ [_{\text{S}''}$ John $[_{\text{VP}}$ has cancer $]]\ [_{\text{Conj}'}$ and $[_{\text{S}}$ he stopped smoking $]]]$

(53) a. $[\![\textbf{Conj'}]\!]^{p,w} = \lambda p\ .\ [[\![\textbf{and}]\!]^{p,w}([\![\textbf{S}]\!]^{o,w}(p) \wedge [\lambda p'.[\![\textbf{and}]\!]^{h}([\![\textbf{S}]\!]^{p,w}](p)]$ (FAbii)
$= \lambda p\ .\ [[\lambda p'.\lambda q'.\top]([\![\textbf{S}]\!]^{o,w})(p) \wedge [\lambda p'.p' \rightarrow [\![\textbf{S}]\!]^{p,w}](p)]$
$= \lambda p\ .\ \top \wedge (p \rightarrow [\lambda x\ .\ \text{in the past } x \text{ smoked in } w](\text{John}))$ ($[\![\textbf{S}]\!]^{p,w}$)
$= \lambda p\ .\ p \rightarrow$ in the past John smoked in w

b. $\forall \alpha : [\![\alpha]\!]^{o,w} \in Dom([\![\textbf{and}]\!]^{o,w}([\![\textbf{he has cancer}]\!]^{o,w}))$:
$[\![\textbf{Conj'}]\!]^{h}(\alpha) = [\![\alpha]\!]^{p,w}$ (FAci)

(54) $[\![\textbf{ConjP}]\!]^{p,w} = [\![\textbf{Conj'}]\!]^{p,w}([\![\textbf{S''}]\!]^{o,w} \wedge [\![\textbf{Conj'}]\!]^{h}([\![\textbf{S''}]\!]^{p,w})$ (FAbi)
$= [\lambda p\ .\ p \rightarrow$ in the past John smoked in $w]([\![\textbf{S''}]\!]^{o,w}) \wedge \top$
$=$ John has cancer in $w \rightarrow$ in the past John smoked in w

But in order to predict the correct presupposition for filtering cases such as (55a), this weak presupposition is the only option, it seems.

(55) a. John used to smoke, **and** he *stopped* smoking.

b. $[_{\text{ConjP}}\ [_{\text{S'''}}$ John $[_{\text{VP}}$ used to smoke]] $[_{\text{Conj'}}$ and $[_{\text{S}}$ he stopped smoking]]]

(56) $[\![\textbf{ConjP}]\!]^{p,w} = [\![\textbf{Conj'}]\!]^{p,w}([\![\textbf{S'''}]\!]^{o,w} \wedge [\![\textbf{Conj'}]\!]^{h}([\![\textbf{S'''}]\!]^{p,w})$ (FAbi)
$= [\lambda p\ .\ p \rightarrow$ in the past John smoked in $w]([\![\textbf{S'''}]\!]^{o,w}) \wedge \top$
$=$ John used to smoke in $w \rightarrow$ in the past John smoked in w t

The proviso problem The puzzle of presuppositions that are weaker than the perceived inferences is called the proviso problem (Gazdar 1979, Geurts 1996). However, it is not at all clear that weak conditional presuppositions might not be the correct way to go after all. The conditional presupposition looks more appropriate for cases like (57) and (58). Weak presuppositions can always be strengthened. We'll come back to this issue.

(57) If John has lung cancer, he *stopped* smoking.
?⇝ *If John has lung cancer, he used to smoke*

(58) If John is a scuba diver, he'll bring *his wetsuit*
⇝ *If John is a scuba diver, he has a wetsuit*

Conditionals and disjunction It is clear that something parallel to conjunction can be said about conditionals. That is, assuming that conditionals are interpreted as material implication (which is not essential for the present purpose) we attribute to them the same inheritance value that conditionals have, i.e., the filter the presupposition of the consequent:

(59) a. **If** John *stopped* smoking, he has cancer. ⇝ *John used to smoke*
b. **If** John got married, he *stopped* smoking. ⇝ *John used to smoke*
c. **If** John ever smoked, he *stopped*. ⇝̸ *John used to smoke*

For disjunction, on the other hand, it seems that we want to filter the presuppositions of both the first and the second disjunct. The current set-up does not allow to do so. The reason is that the inheritance value of Conj′ is calculated via the third clause of functional application and thus independent of the lexical entry for disjunction. This is done in light of the fact that presuppositions of external arguments seem to project, except that is for disjunction.

(60) a. Either John *stopped* smoking, **or** he doesn't have cancer. ⇝ *John used to smoke*
b. Either John doesn't have cancer, **or** he *stopped* smoking. ⇝ *John used to smoke*
c. Either John never smoked, **or** he *stopped*. ⇝̸ *John used to smoke*
d. Either John *stopped* smoking, **or** never smoked. ⇝̸ *John used to smoke*

We would thus have to make the inheritance value of Conj′ also dependent on disjunction and more generally not compute inheritance values of complex expressions by a general rule. This is what Karttunen and Peters (1979) actually do.

This brings out the problem: it is not clear whether that move is desirable. For instance, is there a two-place verb that filters or blocks the presupposition of its external argument? There are verbs that block the presupposition of their internal argument from projecting (Karttunen 1973):

(61) John promised Mary to introduce her to the king of France.
$\not\rightsquigarrow$ *There is a king of France*

But the presupposition of the subject argument survives:

(62) The king of France promised Mary to marry her. $\rightsquigarrow$ *There is a king of France*

3.3 Description rather than explanation

As acknowledged by Karttunen and Peters (1979) and more strongly stressed by Karttunen (1974), Gazdar (1979), the theory presented only describes the projection facts rather than to explain them. The three semantic values are completely independent from each other and not derived from any deeper insight. How is the inheritance value acquired? Are there languages where the inheritance and presupposition values are different from English? Moreover, given what was just said about disjunction (and possibly also conditionals if we reversed the order of arguments) the purely compositional set-up sketched here will not work.

4 The cumulative theory presupposition projection

In its simplest form this theory states: a complex sentence inherits the presuppositions of all of its parts (Langendoen and Savin 1971). This cannot be right given what we have seen.

Gazdar (1979), however, claims it is right. All the cases of filtering we have seen are instances of presupposition cancellation. In particular, presuppositions can be cancelled on his view in order to avoid a contradictory common ground. For instance, the presupposition of *stop* would have to be cancelled in (63).

(63) *Context: Everyone including the speaker knows that John never smoked.*
John didn't stop smoking. He stopped drinking.

Cancellation via conflicting presuppositions and implicatures Gazdar maintains that potential presuppositions must be cancelled if they conflict with other potential presuppositions:

(64) Either John *stopped* smoking, or he *started* smoking. $\not\rightsquigarrow$ *John used to smoke*
$\not\rightsquigarrow$ *John used to not smoke*

Conversational implicatures conflicting with potential presuppositions also lead to cancellation of the presupposition. Utterance of a conditional implicates that the speaker is not certain that its consequent is true. As a consequence utterance of (65) implicates that the war might not be over. This is in conflict with the presupposition of the factive predicate in the antecedent. The presupposition gets cancelled in order to avoid contradiction.

(65) If Nixon knows that the war is over, the war is over.

Why is the conversational implicature not cancelled in (65)? After all, it is possible to utter (66), which arguably is a case of implicature cancellation.

(66) If Nixon knows that the war is over, the war is over. In fact, the war is over.

Gazdar suggests that both implicatures and presuppositions are factored into the meaning, i.e., he advocates a conventional implicature view of presuppositions. But this factoring in happens in stages. At stage (i) the literal meaning is added to the common ground. At stage (ii) conversational implicatures are factored in unless they conflict with the outcome of stage (i). At stage (iii) presuppositions are factored in, unless they conflict with the outcome of stage (ii).

(67) Given sentence S, enrich common ground c (or rather its context set) as follows (where $a + b$ stands for *increment a with b* which amounts to intersection of a and b if successful):
(i) $c + [\![\mathbf{S}]\!]^{o,w} = c'$ unless $c \wedge [\![\mathbf{S}]\!]^{o,w} = \perp$ in which case stop,
(ii) $c' + \cap\{p : p$ is a conversational implicature of $[\![\mathbf{S}]\!]^{o,w}$ and $c' \wedge p \neq \perp\} = c''$
(iii) $c'' + \cap\{q : q$ is a presupposition of $S_1 \ldots S_n$ and $c'' \wedge q \neq \perp\} = c'''$

Projection from conditionals (68a) is no problem. The presupposition of the antecedent is not in conflict with the conversational implicature that the antecedent might be false. It is inherited. (68b) similarly has no conflict between implicature and presupposition. The presupposition is inherited. (68c), finally, implicates that John might not have smoked. This implicature is added before any presupposition. The conflicting presupposition that John used to smoke can thus not be added anymore. We get filtering.

(68) a. If John *stopped* smoking, he has cancer. ⇝ *John used to smoke*
b. If John got married, he *stopped* smoking. ⇝ *John used to smoke*
c. If John ever smoked, he *stopped*. $\not\rightsquigarrow$ *John used to smoke*

A problem with too strong antecedents There is, however, a problem. (69) would implicate that John might or might not have smoked cigars. This is not incompatible with the presupposition that John used to smoke at all. Thus (69) should presuppose that John used to smoke, which it apparently does not (Soames 1979, 1982).

(69) If John used to smoke cigars, he *stopped* smoking. $\not\rightsquigarrow$ *John used to smoke*

Whenever the antecedent is not equivalent to the presupposition of the consequent but asymmetrically entails it, Gazdar's mechanism fails. Both (70a) and (70b) do not suggest that France has a king. Gazdar only predicts this correctly for (70a).

(70) a. If France has a king, John will invite *the king of France*. $\not\rightsquigarrow$ *France has a king*
b. If France has a blonde king, John will invite *the king of France*. $\not\rightsquigarrow$ *France has a king*

Cumulation plus projection rules? Soames suggests that in addition to Gazdar's mechanism a theory of projection rules is still necessary. That is, something like Karttunen and Peters's 1979 mechanism would be called for in addition. This, of course, would make Gazdar's otherwise explanatory theory as descriptive as Karttunen and Peter's one.

A problem with too weak antecedents According to Gazdar (or Soames' modification thereof) (71) should not presuppose anything. (71) implicates that France might be a monarchy or not. Therefore the presupposition that France has a king is not inherited. However, it seems that (71) has a conditional inference—derived by Karttunen and Peters (1979) as a presupposition—that is not derived by Gazdar.

(71) If France is a monarchy, John will invite *the king of France*. $\not\leadsto$ *France has a king*
$\leadsto$ *If France is a monarchy, France has a king*

Generally, whenever the presupposition of the consequent asymmetrically entails the antecedent, Gazdar predicts no presupposition. But a conditional inference is observed that should somehow be accounted for (Heim 1990, Beaver 2001).

This might explain why (72) is felt to be a bit odd. A speaker who does not know whether John smoked at all, should not really be assuming that if he smoked, he smoked cigars. Gazdar has no way to account for this.

(72) ?If John used to smoke, he *stopped* smoking cigars. $\not\leadsto$ *John used to smoke*
$\leadsto$ *If John used to smoke, he smoked cigars*

So in sum, presupposition cancellation might not exist as a mechanism. This is presuppositions persist and at most get modified by projection.

A problem with quantifiers If presuppositions are always inherited unless cancelled, then what is inherited in quantificational cases such as (73)? According to Gazdar (73) with the LF in (74) should presuppose that $g(1)$ 1 used to smoke which varies with assignments g. Clearly, this is not what we want.

(73) **Everyone** of these ten students *stopped* smoking.

(74) everyone of these ten students 1[t_1 stopped smoking]

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