Presupposition: An (un)common attitude?

Abstract

In this paper I argue that presupposition should be thought of as a propositional attitude. I will separate questions on truth from questions of presupposition satisfaction by making use of a two-dimensional analysis. The update of what is presupposed will be accounted for by eliminating arrows, which also makes possible an appealing analysis of modal subordination.

1 Introduction

In traditional pragmatic theories the notion of context plays two roles: (i) it should contain enough information about the conversational situation to determine what is expressed by a sentence; (ii) it should contain enough information about what the participants of the conversation commonly assume about the subject matter of the conversation to determine whether what is said by a speaker is appropriate or not. The central idea behind Stalnakerian pragmatics is that there is a single notion of context that plays both of these two roles, and that both kinds of information modeled by this single context change during a conversation in an interactive way. A context, modeled by a set of possibilities, represents that what is presupposed by the participants in a conversation.

Despite the fact that Discourse Representation Theory (Kamp, Heim) and dynamic semantics (Groenendijk & Stokhof, Veltman) can be looked upon as attempts to incorporate Stalnaker's ideas into a rigorous theoretical model, the resulting dynamic theories differ on some essential points from Stalnaker's suggestions. First, where Stalnaker always argued that the possibilities that are used to represent contexts should be *possible worlds*, proponents of these dynamic theories account for the antecedent-pronoun relation in terms of possibilities that are *finer-grained* than worlds. Second, although Stalnaker always argued for a dynamic view of language use, he didn't give up the traditional distinction between *content* (truth conditions) and *force* (the way a sentence changes a context) of

an assertion, while in dynamic semantics the meaning of a sentence is equated with its *context-change potential*. Third, where Stalnaker tried to explain *linguistic presupposition* in terms of what *speakers* normally presuppose by their use of these sentences, and thus taking presupposition to be primarily a *propositional attitude*, dynamic semantics either accounts for presuppositions in a way equivalent to Peter's (1977) 3-valued logical account (Beaver, 1996), or (partly) in terms of a syntactic underspecification analysis (v.d. Sandt, 1992).

The three ways in which standard dynamic semantics differs from Stalnaker's original suggestions are closely related to each other.

First, what is presupposed by the participants in a conversation is according to all a crucial contextual parameter to determine content and appropriateness of sentences. Stalnaker argues that it is an attitude playing a role in action very similar to that of belief. As a result it should be modeled in terms of possibilities whose fine-grainedness is relevant for the analysis of deliberation: possible worlds. Dynamic semanticists – following Lewis (1979a) for the analysis of belief – argue that contexts should consist of possibilities much finer-grained than worlds, i.e., world-assignment pairs. In distinction with Lewis (1979a), however, no-one has ever explicitly argued how this fine-grainedness could be relevant for action. Perhaps because proponents of dynamic semantics have given up the idea that contexts represent that what is presupposed, i.e. a propositional attitude of participants in a conversation. Now, Stalnaker (1998) argues for a partly referential analysis of anaphoric pronouns, and one of the main reasons for this – no doubt – is that in this way the fine-grainedness of possibilities could, and should, be that of possible worlds. The reason being that on a referential analysis of anaphoric pronouns the use of a singular pronoun comes with a uniqueness assumption.

Second, a three-valued logic accounts for linguistic presupposition in terms of entailment. One of Stalnaker's reasons to account for the behavior of linguistic presuppositions in terms of what speakers presuppose is to be able to account for the intuition many people have that the truth of the linguistic presupposition of a sentence can be *irrelevant* to the truth or falsity of the sentence, or its *content*. All that matters is whether the linguistic presupposition is already satisfied by the context. As a result, we should be able to determine the truth value of sentences in worlds/possibilities *outside* the context; something that is impossible in standard dynamic semantics because no distinction is made between content and force.

Third, if we want to respect the distinction between content and force, we have to be able to determine the truth value of a sentence containing an anaphoric pronoun in possibilities outside the context. It is not at all clear how to do this when no uniqueness requirement is made on the use of singular pronouns. When such a requirement is made,

however, it is easy to see that the content-force distinction can be maintained.

In a related paper (van Rooy, 2001) I argue to account for the antecedent-pronoun relation in a way that respects the distinction between content and force, and – by adopting a uniqueness requirement for singular pronouns – model possibilities (essentially) as fine-grained as worlds. In this paper I will deal with presuppositions. I will think of presupposition more explicitly as a propositional attitude, account for this attitude in possible world semantics, explain some presuppositional phenomena in terms of it, while respecting the distinction between content and force. Before I will do that, however, I will first state the way in which presuppositions are standardly accounted for within dynamic semantics.

2 Standard Implementation

According to dynamic semantics, the meaning of a sentence is its *context change potential*, where contexts are identified with information states that represent what is commonly assumed in a conversation. The meaning of a sentence is modeled as an *update function* that takes a context as its argument and has the updated context where the sentence is accepted as its value. Assuming that a sentence cannot be used appropriately in a context that does not entail, or *satisfy*, its triggered presupposition, this function will be *partial*.

I limit myself here, and in the rest of this paper, to the propositional case and represent a context, C, by a set of possible worlds. A possible world is a function from atomic formulae to the two classical truth-values. Just like Veltman (1996), I treat *might*, $\Diamond$, as a test-operator. I will follow Beaver (1995) in using a special presuppositional connective '∂'. We might treat disjunction and implication syncategorematically, by having '$A \vee B$' and '$A \rightarrow B$' stand for '$\neg(\neg A \wedge \neg B)$', and '$\neg(A \wedge \neg B)$' respectively. The update function is defined as follows:

- $[A](C) = \{w \in C |\ w(A) = 1\}$, if A is atomic
- $[\neg A](C) = C - [A](C)$
- $[A \wedge B](C) = [B]([A](C))$
- $[\Diamond A](C) = C$, if $[A](C) \neq \emptyset$, $\quad \emptyset$ otherwise
- $[\partial A](C) = C$, if $[A](C) = C$, $\quad$ undefined otherwise

The appealing feature of this analysis of presuppositions within dynamic semantics (as stressed by Heim (1983)) is that it seems to solve the projection problem simply by means of

rules of interpretation. Assuming that context C satisfies presupposition P iff $[P](C) = C$, we can say that sentence A presupposes P iff for all contexts $C, [A](C)$ is defined only if C satisfies P. As a result, it follows for instance that if A presupposes P, sentences of the form $\neg A$, $\Diamond A$, and $A \wedge B$ do so too, but that $B \wedge A$ need not.

3 Presupposition as a propositional attitude

3.1 Motivation

An important insight shared by Stalnaker and Kamp is that we presuppose not only something about the subject matter of conversation, but also about the conversational situation itself. Perhaps the most important kind of information about the conversational situation that agents have presuppositions about is the information that (other) agents presuppose (about the conversational situation). For reasons like this, Stalnaker (1970, 1973, 1974, 1998, 2002) argues that presupposition should be thought of as a propositional attitude.

According to the *functional* analysis of attitudes, an agent stands in a certain attitude relation to a proposition, if by means of this relation, together with the assumption that the agent is rational, we can explain the behavior of the agent. Attitudes are seen as dispositional, or functional, states of a rational agent, and these states are individuated by the role they play in determining the behavior of the agent who is in such a state. This picture suggests that contexts represent presuppositions and should also be thought of as propositional attitudes: we have to know what the speaker is presupposing in order to explain his behavior when he is engaged in a conversation.

According to Stalnaker (1970), we should explain the appropriateness of what someone says not only in terms of what he believes and desires, but also partly in terms of what he presupposes. To be able to explain the actions of rational agents, we must assume that the believers know their own minds, i.e. have *introspective* access to their own minds. But if speech is action, and if the appropriateness of the speech acts of agents is to be explained partly in terms of what agents presuppose, then we also have to assume that the attitude of presupposition similarly allows 'introspective' access to its content:

> The world, as Wittgenstein said, is all that is the case, and a possible world is all that would be the case if that world were actual. Every proposition, relevant or not, that is taken for granted by the participants in a conversation will be true in all of the possible worlds that define the context. [...] Facts about what is presupposed in a context are not only facts about the actual world in which the discourse is taking place (which may or may not be a member of the context

set), but also facts about the worlds that define the context. (Stalnaker, 1998, p. 6)

The concept of presupposition is closely related with that of common knowledge. Presupposition and common knowledge are closely related because in the ideal case the two coincide. The worlds compatible with what is commonly known are in the ideal case the relevant alternatives with respect to which we have to judge the informativity and acceptability of that what is asserted by speakers. Suppose that in a Kripke model K_i and K_j are the reflexive, transitive and symmetric epistemic accessibility relations modeling the knowledge of i and j, the two participants of the conversation.[1] What is commonly known by them can then be represented by $K^*_{\{i,j\}}$, the reflexive transitive closure of $K_i \cup K_j$.[2] What is commonly known by the agents in world w can be represented by $\{v \in W : \ wK^*_{\{i,j\}}v\}$, abbreviated by $K^*_{\{i,j\}}(w)$.

Although in the ideal case the context represents what is common knowledge for the participants in the conversation, it is clear that ideal conditions do not always obtain. For one thing, what is presupposed need not be true: discourse can be based on an assumption that later turns out to be false. So, it seems that presupposition should be associated with common *belief* rather than with common *knowledge*. The attitude of common belief should be based on the *doxastic* accessibility relations of the agents, relations that need *not* be *reflexive*. This non-reflexivity represents the fact that agents can have false beliefs. If presupposition is analyzed as common belief, we correctly predict that also presupposition is a *non-veridical* propositional attitude.

An important motivation for treating presupposition as a *non-veridical* propositional attitude is that we can then respect the traditional distinction between the *content* and the *force* of a speech act (of assertion), and can separate questions of entailment from questions of presupposition satisfaction. The views that we should separate content from force, and valuation of truth from presupposition satisfaction are closely related, and they have been defended consistently over the years by Stalnaker.

> I suggested that an assertion should be understood as a proposal to change the context by adding the content to the information presupposed. [...] Meaning determines the content of an assertion as a function of the context, and the assertion rule takes the prior context set to a posterior context set [...] Some of

[1] A relation R is *reflexive* if $\forall x : \ xRx$; *transitive* if $\forall x, y, z : \ (xRy \ \& \ yRz) \rightarrow xRz$; and *symmetric* if $\forall x, y : \ xRy \rightarrow yRx$.

[2] If $\langle x, y\rangle$ and $\langle y, z\rangle$ are in the union of relations R and R', $R \cup R'$, then both $\langle x, x\rangle$ and $\langle x, z\rangle$ are also in the reflexive transitive closure of $R \cup R'$.

> the dynamic semantic theories subsequently developed by linguists have blurred the distinction between content and force by combining the two steps (meaning plus prior context to content, and prior context plus content to posterior context) into one. [...] I think this streamlined representation captures much of what is important about the dynamic process of speech, but what it leaves out is the possibility of evaluating the truth or falsity of what is said relative to possible situations that are not compatible with the prior context. Sometimes when a statement rests on false presuppositions, the question of the actual truth of the statement does not arise, but other times a speaker may succeed in making a claim that is actually true or false, even when taking for granted, in making the claim, something that is in fact false. In such cases, our semantic theory should tell us what is said, and not just how what is said changes the context. Sentences that say different things in some contexts may nevertheless change contexts in the same way. (Stalnaker, 1999, p. 11)

One example he discusses for which the separation of content from force seems crucial is Donnellan's (1966) case of the referential use of definite descriptions. When the description in the sentence *The man drinking a martini is a philosopher* is used referentially, the proposition intended to be communicated/expressed might be true, although it presupposes a falsehood. Stalnaker (1973, 1974), followed by linguists like Karttunen and Peters (1979), argues that in general the proposition expressed by a sentence might be true independent of the truth of the presupposition: a sentence like *Even Bill likes Mary* can be true without it being unlikely that Bill likes Mary. So, although the use of the sentence gives rise to this presupposition, the sentence by itself doesn't entail it. This suggests that the truth value of, or proposition expressed by, a sentence should be determinable independently of the truth of the presupposition. Note, however, that this is impossible in standard dynamic semantics, where all of the attention is given to the *update* of what is presupposed, and where *truth* is treated as at best a *derived* notion. But if in semantics *truth* and *truth conditions* are of primary importance, we should be able to say when a sentence is true, even if it is interpreted with respect to a presupposition state that is non-veridical. Thus, truth and presupposition satisfaction should be accounted for on *different dimensions*. To be able to do this, we have to define the truth conditions of sentences in a manner different from that of standard update semantics – namely, one that is more independent of the update function of what is presupposed.

The non-veridicality of contexts suggests that we should treat the valuation of truth separately from context change – distinguish content from force. In the remainder of this

paper I will show how we can systematically account for presupposition satisfaction without giving up the possibility of determining the content of a sentence separately from the way it changes the context. For context change, I will rely mainly on work in dynamic epistemic semantics, where updates are defined in terms of *eliminating arrows* instead of eliminating worlds.[3]

3.2 Formalization

When a speaker presupposes something, he presupposes it in a world or a possibility. A possibility will be represented by a *pointed model*, $\langle M, w\rangle$, where $M = \langle W, B_a, B_b\rangle$ and w a distinguished element of W representing the actual world and should be thought of as a valuation function from atomic propositions to truth values. The B_is in the model are accessibility relations that are *serial*, *transitive* and *Euclidean* and represent what is believed by i.[4] I will assume with Stalnaker (2002) that what is presupposed by agent a in a conversation with agent b is what the first agent thinks is commonly believed between a and b. Assuming that B_a represents the doxastic accessibility relation of a, what is presupposed by a in w, abbreviated by $R_a(w)$, is the following set (where * is the transitive closure operator):[5]

- $R_a(w) \quad = \quad (\bigcup_{v \in B_a(w)} B^*_{\{a,b\}}(v))^*$

Presupposition satisfaction suggests that conjunction should be treated in an *asymmetric* way. Most authors agree that one must account for this either *distributively* in terms of Peters' (1975) three-valued logic, or *globally* in terms of context satisfaction in dynamic semantics.[6] In this paper I will make use of insights of many-dimensional logics and of dynamic semantics as well. However, I will do this in an unusual way. First I will assume the two-dimensional (or four-valued) analysis of Herzberger (1973) and Karttunen & Peters (1979) according to which the logic of truth and that of presupposition should be

[3]Updating through the elimination of arrows instead of worlds has been used, among others, by Landman (1986a) and Veltman (1996). Its limitations for multi-agent settings are discussed in Gerbrandy (1999).

[4]A relation R is *serial* if $\forall x : \exists y : xRy$ and Euclidean if $\forall x, y, z : (xRy \;\&\; xRz) \rightarrow yRz$.

[5]The transitive closure of the two Euclidean relations B_a and B_b need not be Euclidean itself. Thus, although negative introspection holds for what is believed, it doesn't hold for what is commonly believed. This only holds in a world w in which $B_a(w) \cap B_b(w) \neq \emptyset$. Of course, once we assume that only those things are presupposed that are explicitly asserted in a conversation, it is very natural to assume that the presuppositional relation respects negative introspection. This will be important later.

[6]One can also easily prove that the two come down to the same thing.

treated at separate dimensions. Karttunen & Peters assume that one then has to represent presupposition and assertion at different dimensions, but this is not needed. Making use of Beaver's (1995) presupposition operator, we will represent an atomic sentence A that presupposes P asserted by speaker i as follows: $\partial_i P \wedge A$. To determine in possibility $\langle M, w\rangle$ whether P is presupposed by i, we have to check what is presupposed in this possibility by i, $R_i(w)$. Thinking of presupposition as a non-veridical propositional attitude, we can account for the dynamic aspects of presupposition satisfaction without giving up the idea behind a two-dimensional analysis of presupposition satisfaction. That is, although we will predict that conjunction behaves *asymmetrically* with respect to presupposition satisfaction, '*and*' will still be treated in a *symmetric* way. The reason is that truth and presupposition satisfaction are defined *separately* from the update function (although they will be defined simultaneously). For the time being I will concentrate only on the truth-conditional connectives. We will assume that a sentence has two values: (i) a sentence is true or false, i.e. 1 or 0; (ii) a sentence has no presupposition failure or it has one, i.e. + or -. The combined *truth* and *presupposition satisfaction conditions* of sentences are given below:

- $[[A]]^{M,w} = \langle 1, +\rangle$, iff $w(A) = 1$ if A is atomic,
- $[[\neg A]]^{M,w} = \langle 1, +\rangle$ iff $[[A]]^{R,w} = \langle 0, +\rangle$
- $[[A \wedge B]]^{M,w} = \langle 1, +\rangle$ iff $[[A]]^{M,w} = \langle 1, +\rangle$ and $[[B]]^{Upd(A,M),w} = \langle 1, +\rangle$
- $[[\partial_i A]]^{M,w} = \langle 1, +\rangle$ iff $\forall v \in R_i(w) : [[A]]^{M,v} = \langle 1, +\rangle$

Observe again that the presupposition value of a conjunction is determined in a *symmetric* way. That is, if either A or B has a presupposition failure, the conjunction $A \wedge B$ will have a presupposition failure as well. However, to determine the presupposition value of a conjunction of the form $A \wedge B$ in possibility $\langle M, w\rangle$, we look at the presupposition value of B in possibility $\langle Upd(A, M), w\rangle$ – the update function is being relevant here. This is the point at which we take over the insights of dynamic semantics. The update of M with A, $Upd(A, M)$ should really be thought of as the change from one model to another. So, from updating model $\langle W, B_a, B_b\rangle$ with a proposition we go to another unique model $\langle W', B'_a, B'_b\rangle$. Assuming that $W' = W$, we take it that only the accessibility relations of the agents involved in the conversation will change. The update $Upd(A, M)$, is defined as follows (assuming that a and b are participants of the discourse and that b believes what a tells him):

- $Upd(A, M) = \langle W, Upd(A, B_a), Upd(A, B_b)\rangle$

Notice that although speaker a will typically already believe what he asserts, the update of accessibility relation B_a with A, $Upd(A, B_a)$, is still required, because the other participants did not yet know that he believes it. The update of an accessibility relation is then defined as below:

- $Upd(A, R) \quad = \quad \{\langle u, v\rangle \in R |\ [[A]]^{R,v} = \langle 1, +\rangle\}$.

Notice that this update function is *eliminative*, but instead of eliminating worlds in $R(w)$ it eliminate tuples, or *arrows*, in R. It eliminates all arrows in R that point to an A-world. This has the effect that after the update of R with A, not only all accessible worlds v verify A, but also all worlds u accessible from v make A true. Thus, after the update with A it is not only presupposed that A, but it is also presupposed to be presupposed that A.

According to the above update function we can account for updates of presupposition states by means of change of accessibility relations. But if a world represents everything that is the case, wouldn't it be more natural to claim that after update the accessibility relation stays the same but the world changes? Indeed, that seems to be the case. Fortunately, however, this is exactly what we have done. Let me explain.

According to *dynamic logic* (Harel, 1984) the meaning of a sentence is seen as a relation between states. Normally states are just seen as states *in* one model, but to account for changes in belief/presupposition we have thought of updates as relations between *pointed models*. But then, what does a pointed model like $\langle M, w\rangle$ represent? Well, we have assumed that a 'naked' world represents only information about propositional variables, and not about what agents believe and/or presuppose in that world. To also represent the latter kind of information we need accessibility relations and other worlds to be given in the rest of the model. Now, if a world is everything that is the case, this means that a world should not be represented by a function from propositional variables to truth values, but rather by a *pointed model*, $\langle M, w\rangle$. So we see that the assumption that an update is defined as a function from one pointed model to another is in accordance with the basic intuition that the world changes after something new is presupposed, if we think of a world as everything that is true in this world according to the model.[7]

If we assume that sentence A presupposes P iff $\forall i : \forall\langle M, w\rangle :$ if $[A]^{M,w} = +$, then $\forall v \in R_i(w) :\ [[P]]^{M,v} = 1$, the above implementation gives rise to the same presuppositional predictions as the standard implementation of the satisfaction account. In particular, on the assumption that *John stopped smoking* gives rise to the presupposition that John used

[7]If we would represent updates (i.e. actions) as formulas too, this would mean, formally, that a model (or *supermodel*) consists of a collection of pointed models and that the meaning of an action can be thought of as an accessibility relation between pointed models. See Baltag (1999) for the general picture.

to smoke, this implementation predicts that sentences like *John didn't stop smoking* and *John stopped smoking and Mary is sick* will also gives rise to this presupposition, but *John used to smoke and he stopped doing so* will never give rise to presupposition failure.

That the predictions of our implementation considered above are the same as according to the standard implementation should not surprise you: they are based on the fact (cf. Gerbrandy, 1999) that updating by eliminating arrows corresponds closely with update in standard update semantics. That is, if we think of worlds just as functions from propositional variables to truth values, it holds for any sentence A, context C and world w: If $C = R(w)$, then $[A](C) = Upd(A, R)(w)$.

Although the predictions of the above implementation of the satisfaction approach are similar to the predictions on the standard approach, there are still some important differences. First, note that by treating presupposition as a propositional attitude, we can evaluate in a *distributive* way whether a presupposition associated with a sentence is satisfied by what the speaker presupposes. This is possible, of course, because we have represented in a single possibility all the information that is normally represented only in a whole context/information state. Second, and related, we can now account for the dominant view in the seventies that presupposition satisfaction and truth should be evaluated at *different dimensions*.

> [...] if presupposition is defined independently of truth-conditions, then we can separate the question of entailment relations from the question of presupposition. [...] one may say that sometimes when a presupposition is required by the making of the statement, what is presupposed is also entailed, and sometimes it is not. One can say that "Sam realizes that P" entails that P –the claim is false unless P is true. "Sam does not realize that P," however, does not entail that P. That proposition may be true even when P is false. All this is compatible with the claim that one is required to presuppose that P whenever one asserts or denies that Sam realizes it. (Stalnaker, 1974, p. 54)

We have already seen that according to Karttunen & Peters (1979) and others a sentence like <u>*Even*</u> *Bill likes Mary* presupposes something that it does not entail. Thus, the sentence can be true without it actually being unlikely that Bill likes Mary, because what is presupposed need not be true. Notice that we can now account for this intuition without assuming with Karttunen & Peters (1979) that we should thus *represent* presuppositions separately from assertions.[8] On the other hand, we can also account for the intuition

[8] Which has interesting consequences with respect to the traditional binding-problem. I will limit myself in this paper to the propositional level, however, and the binding-problem will thus not bother us.

that a factive verb both presupposes and entails that its complement is true.[9] To analyze *Sam realizes that P* we add the following construction to the language: if P is a sentence, $Real(s, P)$ is a sentence too. To interpret the formula we add a primitive reflexive accessibility relation to the model, K_s, modeling what Sam realizes.[10] The formula is then interpreted as follows:

- $[[Real(s, P)]]^{R,w} = 1 \quad \text{iff} \quad \forall v \in K_s(w) : \ [[P]]^{R,v} = 1$

Notice that because K_s is reflexive, according to this analysis the formula entails, but does not presuppose, that P. To account for the presupposition, we represent the sentence *Sam realizes that P* by the following formula $\partial P \wedge Real(s, P)$, which both presupposes and entails that P. If we now represent *Sam does not realize that P* by $\neg(\partial P \wedge Real(s, P))$, this sentence presupposes that P, but can still be true in case P is false (in case $w \notin R(w)$).

4 No cancellation or local accommodation

Consider the following well known problematic examples for the traditional satisfaction theory:

(1) If I *realize* later that I have not told the truth, I will confess it to everyone.

(2) Frank doesn't *know* that the earth is flat, because the earth isn't flat.

(3) a. Either John never used to smoke, or he *stopped* smoking.

b. Either John *stopped* smoking, or he never used to smoke.

These example are problematic for the standard satisfaction approach because this account wrongly predicts in all these cases that the sentences give rise to presuppositional readings that intuitively are not the case. Sentence (1) is wrongly predicted to presuppose that the speaker did not tell the truth; sentence (2) is predicted to presuppose that the earth is flat, which is in conflict with what is asserted; and sentences (3a) and (3b) are predicted to give rise to a presupposition incompatible with what is asserted in the other disjunct, which is absurd.

[9] Throughout the paper I will assume the same for an aspectual verb like *stop*.

[10] Our simple update function for models has limitations here: if we would attribute to Sam attitudes about what the discourse participants believe, things go wrong. I will ignore such attributions in this paper. See Baltag (1999) and Gerbrandy (1999) for analyses where this can be accounted for too.

Traditionally, these examples gave rise to the hypothesis that presuppositions can sometimes be *cancelled* for reasons of informativity,[11] and in more recent discussions, Heim (1983) and van der Sandt (1992) argue that presuppositions should sometimes be *locally accommodated*. But there are problems with both proposals, both formally and conceptually. The *formal* problem is that it is not at all clear how to account for cancellation and/or local accommodation in the framework of the satisfaction approach. The *conceptual* problem for cancellation is that it becomes unclear why the presupposition trigger was used in the first place, and for local accommodation how to explain what is supposed to be going on when we locally accommodate a presupposition.

In the rest of this paper I will suggest how to account for these apparent counterexamples of the satisfaction analysis by assuming that there might be more than one information state around that could satisfy the triggered presupposition. I will do this all in terms of the above stated possible world analysis.

4.1 Conditionals

Let's first discuss conditional sentences. I will follow Stalnaker (1968) in assuming that both indicative and subjunctive conditionals should be analyzed in terms of selection functions/similarity relations. Let us assume with Stalnaker and Lewis that there exists a similarity relation between worlds, $u \leq_w v$, meaning that u is at least as close to w as v is. To let the selection explicitly depend on what is presupposed, I will assume that the $\leq_w$ relation ignores what agents presuppose in the worlds. Instead, I will define a new relation $<_{R,w}$ between possibilities that is dependent both on $\leq_w$ and on what is presupposed in $\langle R, w\rangle$ (where $<_w$ and $\approx_w$ are defined in terms of $\leq_w$ in the usual way, and where R is the presuppositional accessibility relation of the speaker):[12]

- $\langle R', v\rangle <_{R,w} \langle R'', u\rangle$ iff (i) $v <_w u$, or
  (ii) $v \approx_w u$ and $R''(u) \subset R'(v) \subseteq R(w)$, or
  (iii) $v \approx_w u$ and $R(w) \subseteq R'(v) \subset R''(w)$

Thus, $\langle R', v\rangle$ is closer to $\langle R, w\rangle$ than $\langle R'', u\rangle$ iff either u is closer to v, or they are equally close, but what is presupposed in $\langle R', v\rangle$ is more similar to what is presupposed in $\langle R, w\rangle$ than what is presupposed in $\langle R'', u\rangle$. The set of closest A-possibilities to $\langle R, w\rangle$ is the following set:

[11] We might interpret the proposals of Gazdar (1979), Soames (1982), van der Sandt (1988), and some remarks of Stalnaker (1974) in this way.

[12] In this subsection I will ignore the possibilities that more than one presupposition state might be around.

- $f_{\langle R,w\rangle}(A) \;=\; \{\langle R',v\rangle |\; [[A]]^{R',v} = \langle 1,+\rangle \;\&\; \neg\exists\langle S,u\rangle :$
$[[A]]^{S,u} = \langle 1,+\rangle \;\&\; \langle S,u\rangle <_{\langle R,w\rangle} \langle R',v\rangle\}$

A conditional sentence of the form *if A then B* is then counted as true in $\langle R,w\rangle$ iff all the with A updated closest A-possibilities to $\langle R,w\rangle$ are B-possibilities:

- $[[A > B]]^{R,w} = \langle 1,+\rangle \quad \text{iff} \quad f_{\langle R,w\rangle}(A) \subseteq \{\langle R',v\rangle |\; [[B]]^{Upd(A,R'),v} = \langle 1,+\rangle\}$

Following Stalnaker's (1975) suggestion that the antecedent of an indicative conditional selects, if possible, worlds compatible with what is presupposed, I will assume that for such conditionals the selection function has to satisfy the following condition:

- $f_{\langle R,w\rangle}(A) \subseteq \{\langle R',v\rangle |\; v \in R(w) \;\&\; R' \subseteq R\}$

Now we are ready to discuss a traditional problem for the satisfaction approach.[13] Karttunen (1971) and Stalnaker (1974) noted that although the following sentences intuitively express the same proposition, it is clear that the speaker of (4b) will not presuppose that Harry has not told the truth, while the speaker of (4a) typically does.[14]

[13] According to Geurts (1996) conditional sentences are a major problem for the satisfaction approach towards presuppositions. This is already the case, according to Geurts, when conditional sentences are analyzed as material implications, but problems even increase, still according to Geurts, when the sentences are analyzed in terms of similarity relations. Assuming that $\psi\{\chi\}$ means that sentence ψ presupposes χ, and that conditionals are analyzed in terms of similarity, Geurts claims the following:

> [...] the satisfaction theory implies that even if χ is contextually given, the presupposition in $\phi > \psi\{\chi\}$ isn't automatically satisfied – a consequence which strikes me as paradoxical if not absurd. (Geurts, 1996, p. 282)

Paradoxical or not, it is exactly what Heim's (1992) analysis of conditional sentences in her context change analysis of presuppositions predicts. She analyzes presuppositions as we did in section 2, and proposes the following analysis for conditionals (where f is a function which assigns to a world and a set of worlds a subset of the latter):

- $[A > B](C) \quad = \quad \{w \in C |\; f_w([A](\bigcup\{K \supseteq C |\; [A](K) \text{ is defined}\}))$
$= [B]f_w([A](\bigcup\{K \supseteq C |\; [A](K) \text{ is defined}\}))\}$

But this has the unwanted prediction Geurts points to. Notice, however, that this wrong prediction has nothing to do with the satisfaction analysis per se, but only follows from Heim's particular implementation of things. In fact, the analysis I propose in this section doesn't give rise to this unwanted prediction.

[14] The contrast between the sentences is, of course, closely related with the contrast between the following sentences, of which only the latter gives rise to Moore's paradox:

(i) The cat is on the mat, but *Harry* doesn't believe it.

(ii) ?The cat is on the mat, but *I* don't believe it. (said by Harry)

(4) a. If *Harry realizes* later that he has not told the truth, he will confess it to everyone.

b. If *I realize* later that I have not told the truth, I will confess it to everyone (said by Harry).

Both antecedents presuppose that Harry has not told the truth. Why does the first conditional also has this presupposition, but not the second? Notice, first, that everything else being equal, if $R'(v) = R(w) \neq R''(u)$, $\langle R', v\rangle$ is considered to be closer to $\langle R, w\rangle$ than $\langle R'', u\rangle$: possibilities where the same is presupposed as in $\langle R, w\rangle$ are preferred to possibilities where something different is presupposed. This explains why in normal cases like (4a) the presupposition of the antecedent is also a presupposition of the whole conditional. To explain why this is not the case for (4b), let's see again how we represent the antecedent of this sentence (where I assume that the speaker is h): $\partial_h P \wedge Real(h, P)$. Notice that for possibility $\langle R', v\rangle$ to be among the selected ones, it has to be the case that the speaker, i.e. h himself, presupposes in this possibility that P is true, otherwise the formula cannot be true and appropriate in $\langle R', v\rangle$. But this means that what is presupposed in $\langle R', v\rangle$ cannot be the same as what is presupposed in $\langle R, w\rangle$, otherwise the antecedent would not be informative anymore with respect to what the speaker presupposes.

> [...] If a speaker explicitly supposes something, he thereby indicates that he is not *pre*supposing it, or taking it for granted. So when the speaker says "if I realize later that P," he indicates that he is not presupposing that he will realize later that P. But if it is an open question for a speaker whether or not he will at some future time have come to realize that P, he can't be assuming that he already knows that P. And if he is not assuming that he himself knows that P, he can't be assuming that P. Hence P cannot be presupposed. (Stalnaker, 1974, p. 208)

To account for this informativity, it has to be the case that $R(w)$ contains worlds in which P is false. But this means that any selected possibility $\langle R', v\rangle$ must be such that $R'(v) \neq R(w)$. Because any selected possibility $\langle R', v\rangle$ verifies the 'fact' that P is presupposed, the presupposition is satisfied in its local context. Still, it is not a presupposition of the whole conditional because $\langle R, w\rangle$ will not verify the 'fact' that P is presupposed.[15] Notice that according to this analysis we don't need to assume anything like local accommodation. Still, the effect of our analysis will be very similar to the standard local

[15]Given our analysis of modal subordination below, it seems natural to assume that for $A > B$ to have value $\langle 1, +\rangle$ in $\langle R, w\rangle$, it has to be the case that $[[\Diamond A]]^{R,w} = \langle 1, +\rangle$.

accommodation approach. The reason is that the possibilities $\langle R', v\rangle$ with respect to which the antecedent will be evaluated will be closely related with the possibility resulting after accommodation of 'original' possibility $\langle R, w\rangle$ with the presupposition P of the antecedent: $R(w) \cap P = R'(v)$.

Now consider the following type of example discussed by Landman (1986b):

(5) If John *regrets* that it snows heavily, then at least it snows.

The standard satisfaction account predicts wrongly, again, that this kind of conditional inherits the presupposition of its antecedent. Landman (1986b) proposes to avoid this false prediction by adopting the following rule: *if ϕ presupposes ϕ' then the assertion $\phi \rightarrow \psi$ presupposes ϕ' unless ϕ' already provides an answer to the question whether the consequent ψ is true.* This rule has much in common with Gazdar's (1979) cancellation approach and that's exactly what we wanted to avoid. On our analysis of conditionals, however, we don't need the rule, but just an additional constraint on the selection function. Notice first that our analysis would not predict that out of context (5) is inappropriate in case it is not presupposed yet that it snows heavily: in special circumstances, what is presupposed in the selected possibilities need not be the same as what is presupposed in the actual possibility. As we saw above, these special circumstances can have something to do with the informativity of the *antecedent* of the conditional. Landman's examples show, however, that they can involve the informativity of the *consequent* as well. It is natural to demand (cf. Gazdar's clausal implicatures) that the truth value of the consequent of an indicative conditional is not yet settled by what is actually presupposed. Thus, if $\langle R, w\rangle$ is the actual possibility, both the consequent and its negation should be consistent with $R(w)$. But this means that for the interpretation of (5), $R(w)$ cannot yet contain the information that it snows. Because the antecedent presupposes it, we predict that for each selected possibility $\langle R', v\rangle$ with respect to which the antecedent has to be interpreted, it holds that $R(w) \neq R'(v)$. Again, the analysis has the same result as what is supposed to happen if we allow for cancellation or local accommodation, but the idea behind my proposal is very different.

4.2 Denials

Following Stalnaker (2002), I defined what is presupposed by a in w in terms of what a *believes* is common ground. Agents a and b might believe different things, in particular about what is common ground. Indeed, there is no reason to assume why $R_a(w) = R_b(w)$. Thus, in a conversation between a and b there might be several presupposition states

around. Because it is the *speaker* who is responsible for what she says, the presuppositions of what she says should in the first place be satisfied with respect to her own presupposition state. This, at least, is normally the case. However, so I want to argue, this is not so for sentences like:

(2) Frank doesn't *know* that the earth is flat, because the earth isn't flat.

This example is problematic for the standard satisfaction approach, because it both presupposes that the earth is flat, and asserts that the earth is not flat. If truth and presupposition satisfaction should be analyzed with respect to the same context, how should we account for such examples? The standard answers, as we have seen, are *cancellation* and *local accommodation*. In this section I want to suggest that (2) does indeed give rise to the presupposition that the earth is flat, as the standard satisfaction account predicts, but that it is not the presupposition of the *speaker*, but rather that of the *addressee*. The idea is that a sentence like (2) is typically uttered after the other participant in the conversation has made clear (perhaps, but not necessary, by an explicit claim) that he presupposes that the earth is flat. In terms of van der Sandt (1991), this means that (2) is typically used as a *denial*. To account for the intuition that sometimes a speaker indicates that a presupposition is made not by himself, but rather by the other participant in a conversation, we will index the presupposition operator by the relevant agent. Thus, $\partial_j P$ will mean that agent j presupposes that P is the case. As might be expected, we will represent (2) by the following formula:

(6) $\neg(\partial_j P \wedge know(f, P)) \wedge \neg P$

Assuming that K_f is the reflexive accessibility relation that models what Frank knows, the first conjunct is analyzed as follows:

- $[[\neg(\partial_j P \wedge know(f,\ P))]]^{M,w} = \langle 1, + \rangle$ iff $[[\partial_j P \wedge know(f, P)]]^{M,w} = \langle 0, + \rangle$ iff
  $\forall v \in R_j(w):\ [[P]]^{M,v} = 1$ and $[[know(f, P)]]^{M,w} = 0$ iff
  $\forall v \in R_j(w):\ [[P]]^{M,v} = 1$ and $\exists u \in K_f(w):\ [[P]]^{M,u} = 0$

Notice that this first conjunct is obviously compatible with the second one: if, and only if, w doesn't make P true and $w \notin R_j(w)$ both conjuncts can be true. The point of what the speaker says by (2) is in fact that the other participant presupposes something that is false: the sentence as a whole can be true only in case R_j is non-reflexive. Thus, we might say, the sentence is used as a presuppositional denial. We can conclude that to account for denials we don't have to assume that presuppositions are cancelled or locally accommodated: they have to be satisfied, but not necessarily by the information state that represents what the *speaker* presupposes.

4.3 Disjunction

The standard satisfaction analysis of presuppositions predicts that the following sentences presuppose that John used to smoke.[16]

(3a) Either John never used to smoke, or he *stopped* smoking.

(3b) Either John *stopped* smoking, or he never used to smoke.

Karttunen (1974) suggested that this problem can be overcome when we assume that the context with respect to which we evaluate the appropriateness of one disjunct is the initial context updated with the negation of the other disjunct. However, as already noted by Karttunen himself, this won't work for a sentence like

(7) Either John *stopped* smoking, or he just *started* doing so.

Gazdar (1979), Soames (1979, 1982) and van der Sandt (1982, 1988), among others, propose to account for all of (3a), (3b) and (7) by assuming that presuppositions of parts of complex sentences can sometimes be *cancelled*,[17] for reasons of *inconsistency*. In this case, because the presupposition of the one disjunct would be in contradiction with what is asserted (or presupposed) by the other.

To account for cancellation, Gazdar, Soames, and van der Sandt must assume that what is presupposed by the embedded clauses is also entailed by it. This avoids the implausible claim that presupposition triggers sometimes have no effect at all on the semantic/pragmatic meaning of the sentence. Not happy with the prediction that all triggers should have not only presuppositional but also assertive content, however, Heim (1983) and van der Sandt (1992) argue that in cases like (3a), (3b) and (7) the triggered presuppositions should be *locally accommodated*.

In the previous section we saw that we can account for cases where others have made use of local accommodation, and now we will propose a similar approach by following a suggestion of Landman. Landman (1986b) proposes a solution in the spirit of the satisfaction approach by making use of Robert's (1989) analysis of *modal subordination*. Landman argues that to account for (7), we should make the assumption that the embedded clauses should not be interpreted with respect to the main context, but with respects two mutually exclusive *subordinated contexts*, possibly created by an earlier use of a disjunctive sentence that has *split* the context. But how can this be done without giving up our assumption that what is presupposed can be represented by a single accessibility relation? Before we will answer this question, it is useful to discuss first a simpler case.

[16] Although if we treat $A \vee B$ as an abbreviation for $\neg(\neg A \wedge \neg B)$ this isn't really true for (3a).

[17] Although certainly Gazdar would not describe matters this way.

5 Modal subordination

5.1 Possibility

In section 2 we followed Veltman's (1996) analysis of *possibly*: the embedded sentence of 'possibly A' should be interpreted with respect to the same context as the whole sentence. It is easily seen, however, that sometimes this predicts too strong presuppositions. It is predicted that (8a) presupposes (8b).

(8) a. It is possible that John *stopped* smoking.

b. John used to smoke.

However, if it has already been established that it is possible that John used to smoke, (8a) need not presuppose (8b). Consider (9a) and (9b).

(9) a. It is *possible* that John used to smoke,

b. and it is *possible* that he just *stopped* doing so.

The most natural explanation for the fact that (9b) does not give rise to the presupposition that John used to smoke seems to me that the embedded sentence in (9a) introduces a subordinated context into the discourse that contains this information. How can we account for the introduction of these subordinated contexts without giving up that we represent what is presupposed in terms of a *single* accessibility relation?

Until now we have assumed with Stalnaker that what is presupposed can be determined in terms of what is believed by the participants of the conversation. Discourse has an effect on what is believed, and thus indirectly on what is presupposed. According to Kamp's discourse representation theory, discourse has a more direct effect on what is presupposed. Here, a context, or DRS, represents what is *explicitly* agreed upon by the participants of a conversation. This suggests that what is presupposed should be represented by a separate and *primitive* accessibility relation. As before, I will denote this accessibility relation by R, but now I assume that it represents what is established to be presupposed in a discourse. Moroever, the assumption that R represents only what conversational partners explicitly agree upon suggests that it – in contrast to what we had earlier – is by default fully introspective:[18] R is not only serial and transitive, but also *Euclidean*. This means that

[18]See also Fernando (1995) for an analysis of context where full introspection is assumed. He does not account for this, however, in terms of an accessibility relation.

for all worlds u and v accessible from w, it holds that $\langle u, v\rangle \in R$. I will show now that in terms of such a primitive accessibility relation we can account for sequences like (9a)-(9b).

The basic idea is very simple: possibility statements introduce *questions* into the discourse. However, because we assume that what is presupposed is a presuppositional attitude and should be represented by an accessibility relation, we can implement this idea in an appealing way. Following Groenendijk & Stokhof (1984), I will represent a question by a partition or equivalence relation, and with Groenendijk (1999) I will assume that the dynamic effect of a question is to add a partition to the context by *eliminating arrows*.[19]

- $Upd(\Diamond A, M) \;=\; \{\langle u, v\rangle \in R|\ [[A]]^{M,u} = \langle 1, +\rangle \text{ iff } [[A]]^{M,v} = \langle 1, +\rangle\}$

According to the update function, possibility statements split the context by *disconnecting* A-worlds from $\neg A$-worlds. They do so by eliminating arrows between A-worlds and $\neg A$-worlds consistent with what is presupposed (although A-worlds and $\neg A$-worlds are still accessible from actual world w). Thus, if R_i was Euclidean before the update with $\Diamond A$, it won't be Euclidean anymore afterwards. Possibility statements will be interpreted from now on as follows:

- $[[\Diamond A]]^{M,w} = \langle 1, +\rangle \quad \text{iff} \quad \exists v \in R(w) : [[A]]^{M,v} = \langle 1, +\rangle$

According to the appropriateness condition it holds that if A presupposes P, $\Diamond A$ can be used appropriately only if it is assumed to be possible that P is presupposed. Because out of context (or so we assumed) it holds that $\forall v \in R(w) : R(v) = R(w)$, under normal circumstances the truth condition just states that $\Diamond A$ presupposes the same as A itself. However, it can also account for the sequence (9a)-(9b). After the interpretation /update of (9a) there is a world v consistent with what is presupposed in the actual world w in which John used to smoke and in which it is presupposed that John used to smoke. It is important to see that from this world only worlds are accessible in which John used to smoke. But this means that the embedded sentence of (9b) can be interpreted appropriately as well.

Under which circumstances does it make sense to assume that it is possible that P is presupposed? On our assumption that by default, or out of context, the accessibility

[19]This update rule is defined on the assumption that $w \notin R(w)$, because otherwise we would falsely predict that if w is an A-world (or $\neg A$-world), the use of the possibility statement would predict that only other A-worlds (or only other $\neg A$-worlds) would be accessible from w. In general we cannot make this assumption, of course. Fortunately, we can use a technical trick to solve this problem. Assume that if $w \in R(w)$, we don't go to new pointed model $\langle R', w\rangle$, but rather to the pointed model $\langle R', w^*\rangle$ with a new world w^*. This new world is exactly like w of the original pointed model, except that $w^* \notin R(w^*)$. Because our technical problem has a simple solution, I will ignore this complication in the main text. (Thanks to Frank Veltman and Henk Zeevat for discussion on this point).

relation R_i is fully introspective, this is the case only if P itself is presupposed. Thus, if (9b) was used out of context, it is correctly predicted that John used to smoke should be presupposed already in the actual world. As a result, we predict that possibility statements normally presuppose the presuppositions of its embedded sentences, but not in case the possibility that this presupposition is true has been explicitly mentioned earlier in the discourse.

Of course, our analysis of modal subordination has *some* similarity with the anaphoric ones proposed by Kibble (1994), Geurts (1995, 1998), and Frank (1997). Also they are able to account for the intuition that the sequence (9a)-(9b) does not give rise to the presupposition that John used to smoke. However, I believe that my analysis is much more appealing: not only do they need an extra representation which mine does not, their analyses are also much weaker: they just introduce subordinated contexts to the discourse that can be anaphorically picked up freely by any other sentence. Only good luck can save them from making false predictions. Moreover, their analysis do not account for the following classical sequence, while mine seems to do so:

(10) a. It is possible that John doesn't have children,

b. but it is also possible that *his children* are not home.

However, although the update with $\Diamond A$ partitions the context, there is a contrast between accessible A-worlds and accessible $\neg A$-words: the former are guaranteed to exist, while the latter are not.

5.2 Some other cases

Consider (7) again.

(7) Either John *stopped* smoking, or he just *started* doing so.

We saw above that Landman proposed to account for such examples by assuming that the disjuncts should be interpreted with respect to two mutually exclusive *subordinated contexts*, possibly created by an earlier use of a disjunctive sentence that has *split* the context. We didn't know how to account for this before. Our analysis of possibility statements, however, suggests a straightforward solution:

- $[[A \vee B]]^{M,w} = \langle 1, + \rangle$ iff $[[A]]^{M,w} = \langle 1, \cdot \rangle$ or $[[B]]^{M,w} = \langle 1, \cdot \rangle$ and $[[\Diamond A]]^{M,w} = \langle 1, + \rangle$ and $[[\Diamond B]]^{M,w} = \langle 1, + \rangle$

- $Upd(A \vee B, M) \;=\; Upd(A, M) \cup Upd(B, M)$

Thus, I propose that $A \vee B$ is appropriate iff both $\Diamond A$ and $\Diamond B$ are appropriate. As for the case of possibility statements, this means that normally all the presuppositions of the disjuncts are also presuppositions of the whole disjunction. However, when the context is split, this doesn't have to be the case. This accounts for the problematic (7), if we assume that the context was split (perhaps after accommodation of the disjunctive presupposition) between, on the one hand, worlds where John smoked before, and, on the other, worlds where he did not.

Notice that a context can be split in this way both by possibility operators and by disjunctions (in case the disjunctions are mutually contradictory). Of course, it can be split by *questions* as well. Indeed, we can simply assume that the update of R with the yes/no question A? is the same as the update of R with $\Diamond A$. And this gives rise to the following correct predictions: after question (11a), both (11b) and (11c) are appropriate and do not give rise to presuppositional readings:

(11) a. Did anyone solve the problem?

b. It is possible that *it was* John *who* solved the problem.

c. Either *it was* John *who* solved the problem, or the problem was too difficult.

What is presupposed by A is normally also presupposed by $\neg A$. In section 4, however, we discussed an example for which this doesn't seem to be true, but suggested that in this case it is just presupposed by another participant of the conversation. Unfortunately, not all counterexamples to the standard implementation of the satisfaction theory can be handled this way. Consider the following example:

(12) A: I don't have a dog.

B: So at least you don't have to walk *your dog*.

In this example, speaker B does not presuppose that speaker A has a dog, although that is what we would predict until now. It is clear that also the other participant of the conversation does not presuppose that he has a dog: what B says should not be interpreted as a denial. Still, her assertion should be interpreted in a special way, because it cannot be a standard *informative* assertion where some possibilities consistent with what is presupposed are eliminated. I believe this is the crucial aspect of this example. To make sense of it, I propose to slightly change the presuppositional value of negative sentences as follows (where $M[^{R}/_{R'}]$ is just like M except that R is replaced by R'):[20]

[20]The update function is still defined in the old way.

- $[[\neg A]]^{M,w} = \langle 1, + \rangle$ iff $[[A]]^{M,w} = \langle 0, + \rangle$, if $\exists v \in R(w) : [[A]]^{M,v} = \langle 1, + \rangle$
  iff $[[A]]^{M[{}^{R}/_{W^2-R}],w} = \langle 0, + \rangle$ otherwise.

Thus, $\neg A$ should be interpreted with respect to the same presupposition set as A – and has thus the same presupposition as A has –, if it is presupposed to be possible that A is true (remember that most simple sentences entail their presuppositions). Otherwise it should be interpreted with respect to the complement of what is presupposed (note that $R \subseteq W^2$). This means that if negative sentences are used in the normal, informative, way, they presuppose the same as their positive counterparts. In special cases as in (12), however, when their positive counterpart is already ruled out, the negated clause is interpreted with respect to the complement of what is presupposed.

6 Conclusion

In this paper I have argued that presupposition should be thought of as a propositional attitude. This allows us to account for linguistic presuppositions independently of truth conditions, which enables us to separate the question of entailment relations from the question of presupposition. Our analysis differs from other two-dimensional analyses of presupposition proposed in the seventies because it doesn't have to assume that the assertive and presuppositional part of an utterance should be represented at separate representations. Furthermore, I have suggested how this analysis might account for some (apparent) counterexamples of the satisfaction approach by assuming that there might be more than one information state around that could satisfy the triggered presupposition.

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