

1 File Change Semantics

Heim (1983) proposes a treatment of presupposition in the framework of File Change Semantics (FCS, Heim 1982). Heim (1982) develops File Change Semantics for definite descriptions and pronouns,¹ but we will put it aside here and focus on presuppositions.

The denotations of (declarative) sentences in FCS are not truth-values but *Context Change Potentials (CCPs)*, which are functions from contexts to contexts. The idea is that the meaning of a sentence is instructions about how to update the current context and obtain a new context. In order to make sense of CCPs, we need to make assumptions about what contexts are.

1.1 Stalnakerian View of Contexts

A context is assumed to represent the *Common Ground* among the participants of the conversational context, which is the information shared by all the discourse participants.

Following Stalnaker (1973, 1974, 1978), let us represent the Common Ground in c by the *Context Set*, which is the set of possible worlds that are compatible with the shared knowledge of the discourse participants (see Stalnaker 1998, 2002 for further refinements).

- (1) Suppose a_1, \dots, a_n are the conversational participants in the context. The Context Set C is the strongest proposition (= the smallest set of possible worlds) such that:
 - a. Each a_i believes that C ;
 - b. Each a_i believes that each a_j believes that C ;
 - c. Each a_i believes that each a_j believes that each a_k believes that C ;

...

One could see C as the grand conjunction of all the propositions that are mutually believed to be true by the discourse participants.

(In order to deal with quantificational sentences, we will augment context sets with assignment functions later.)

¹Her view of definite descriptions was revised subsequently in Heim (1991) and Heim (2011). She also proposes an alternative analysis of pronouns in Heim (1990).

1.2 The CCPs of Atomic Sentences

An atomic sentence is used to update the current Context Set by sifting out those possible worlds that are not compatible with what is conveyed by the sentence. Formally, an atomic sentence p can be seen as a (partial) function over contexts. Instead of the usual function notation $p(c)$ it is customary to write $c[p]$ (or $c + p$).

$$(2) \quad c[p] = \{ w \in c \mid w \models p \}$$

Here's a concrete example with an English sentence. To simplify, we will ignore tense and aspect.

$$(3) \quad c[\text{it is raining}] = \{ w \in c \mid \text{it is raining in } w \}$$

This captures the dynamics of information flow in a conversation. Suppose that before the utterance of *It is raining*, the Context Set contained possible worlds where it is raining and worlds where it is not raining, representing a state of ignorance with respect to this information. After the utterance, a new Context Set emerges that only contains possible worlds where it is raining, which represents a state where all the discourse participants commonly believe what had just been asserted.

Classical static truth-conditional semantics is subsumed by this framework, as truth-conditions can be defined in terms of CCPs:

$$(4) \quad \text{'It is raining' is } \begin{cases} \text{true in } w & \text{if } \{ w \} [\text{it is raining}] = \{ w \} \\ \text{false in } w & \text{if } \{ w \} [\text{it is raining}] = \emptyset \end{cases}$$

But FCS can do something that classical semantics cannot do. It can refer to c as a whole, rather than each possible world individually.

Heim's (1983) idea about presuppositions is that they are pre-conditions for CCPs to apply successfully (again, we ignore tense and aspect for now).

- (5) c satisfies the presupposition of 'It stopped raining' iff for all $w \in c$, it was raining in w
- (6) a. Whenever c satisfies the presupposition of 'It stopped raining', $c[\text{It stopped raining}] = \{ w \in c \mid \text{it is no longer raining in } w \}$
 b. If c does not satisfy the presupposition of 'It stopped raining', an utterance of this sentence is infelicitous in c .

We could model presuppositions with partial functions:

- (7) a. $c \in \text{dom}([\text{It stopped raining}])$ iff for all $w \in c$, it was raining in w .
 b. Whenever $c \in \text{dom}([\text{It stopped raining}])$, $c[\text{It stopped raining}] = \{ w \in c \mid \text{it is no longer raining in } w \}$.

1.3 Negation

Non-atomic sentences update the context set with the CCPs denoted by their component sentences in a stepwise fashion. Heim (1983) defines negation as follows.

$$(8) \quad c[\text{not } \phi] = c - (c[\phi])$$

To compute $c[\text{not } \phi]$ you first update c with ϕ , and then subtract the resulting possible worlds from c .

Heim (1983) proposes that the presupposition needs to be satisfied at every update step. In this case, $c[\phi]$ needs to be computed, so it is required that $c \text{dom}([\phi])$. This means that c needs to satisfy the presupposition of ϕ . As a result, $c[\text{not } \phi]$ has the same presupposition as $c[\phi]$. In other words, the presupposition projects out.

As we have already seen, this is a good result, because the following two sentences have the same presupposition.

- (9) a. It stopped raining.
- b. It's false that it stopped raining.

We will refer to the context that a given CCP is used to update as its *local context*, and the context that the entire sentence takes as its *global context*. In the above example, the global context and local context are identical, c . But this is not always the case.

1.4 Conjunction

Conjunction is defined as follows:

$$(10) \quad c[\phi \text{ and } \psi] = c[\phi][\psi]$$

Crucially, ϕ is processed *after* ψ , and its local context, namely $c[\phi]$, is (potentially) distinct from the global context c .²

The presupposition of the second conjunct ψ needs to be satisfied in its local context $c[\phi]$, rather than in the global context c . Following Heim's recipe:

- (11) a. $c \in \text{dom}([\phi \text{ and } \psi])$ iff $c \in \text{dom}([\phi])$ and $c[\phi] \in \text{dom}([\psi])$.
- b. Whenever defined, $c[\phi \text{ and } \psi] = c[\phi][\psi]$

Consequently, ' ϕ and ψ ' does not always presuppose what ψ alone presupposes: even when the global context c does not satisfy the presupposition of ψ *per se*, ' ϕ and ψ ' may be able to update c , if ψ 's local context $c[\phi]$ satisfies the presupposition of ψ , e.g.

²This is only the case if the update with ϕ is not trivial in c , i.e. $c[\phi] \neq c$. For natural language pragmatics, it is reasonable to require each utterance to be non-trivial. See Stalnaker (1973, 1974, 1978) for discussion.

- (12) a. It was raining in the morning, and it stopped raining in the afternoon.
- b. Bill used to be a smoker but he quit smoking a week ago.

These conjunctive sentences as a whole presuppose nothing, i.e. they can update any context. The presupposition of the second conjunct is not satisfied in the global context but is satisfied in the local context.

Here, the presupposition of ψ is discharged by a prior update. In such cases, we sometimes say the presupposition gets *filtered* by the first conjunct.

Exercise: What's the predicted presupposition for the conjunctive sentence in (13)? Is this a problem?

- (13) It is raining, and Mary's sister is reading *War and Peace*.

1.5 Conditional

Heim's (1983) analysis of *if*.³

$$(14) \quad c[\text{if } \phi, \text{ then } \psi] = c - (c[\phi] - c[\phi][\psi])$$

The local context for ϕ is the global context c . The local context for ψ is $c[\phi]$, as in the case of conjunction. Thus, the predictions are: the presupposition of ϕ projects out, while the presupposition of ψ gets filtered by ϕ , as in the case of conjunction.

Let's verify these predictions with some examples:

- (15) a. If Mary quits smoking today, then she will live long.
 presupposition: Mary has been a smoker
- b. If Mary has a laptop and a tablet, then she can lend you her tablet.
 no presupposition

Exercise: What does the theory predict for (16)? Is it a problem?

- (16) If John flies to Berlin, then his sister will pick him up.

- (17) If John bought an apartment, then Mary did something idiotic too.
 presupposition: buying an apartment is idiotic for John to do

1.6 Disjunction

What is the projection behaviour of disjunction? There are some theoretical possibilities.

³It seems she doesn't really think this is the right analysis; in part because the meaning of *if* should not be material implication.

Possibility 1: Symmetric disjunction (Simons 2000, Geurts 1999)

$$(18) \quad c[\phi \text{ or } \psi] = c[\phi] \cup c[\psi]$$

According to (18), you update c with ϕ and ψ separately, and take the union of the two resulting contexts.

This analysis looks fine for (19): the presupposition of both conjuncts seem to project out.

- (19) a. Either John's sister came to the party, or Mary did.
b. Either Mary came to the party, or John's sister came to the party.

Both of these sentences seem to presuppose that John has a sister.

Exercise: Here's an example that is problematic for (19):

- (20) Either John has no children or his children do not live with him.

Explain why (20) is problematic for (19).

Cases of contextual entailment:

- (21) a. Either Geraldine is not a mormon or she has given up wearing her holy underwear. (Karttunen 1973)
b. Either Jack is not a catholic or his rosary was stolen. (Heim's 2015 lecture notes)

Exercise: Come up with an alternative analysis of disjunction that explains (20) and (21). What would it predict for (19b)?

2 Accommodation

Presupposition accommodation is one of the central issues in the current literature on presupposition (see Beaver & Zeevat 2007 for an overview). There are two types of accommodation.

2.1 Local Accommodation

As mentioned in Lecture 1, presuppositions sometimes fail to project.

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

Heim (1983) suggests that such cases, the local context is manipulated so that the presupposition will be satisfied. This operation is called (*local*) accommodation.

More concretely: suppose c does not satisfy the presupposition of *The king of France is bald* and there might or might not be a king of France. Then, [The king of France isn't bald] is undefined for c . Local accommodation is an extra operation of adjusting c so that it satisfies the presupposition in the following manner:

$$(23) \quad c[\text{not}(\text{the king of France is bald})] \\ \rightsquigarrow c - (c[\text{France has a king}][\text{the king of France is bald}])$$

The resulting context is compatible with the non-existence of a French king.

2.2 Global Accommodation

If local accommodation is allowed, the same mechanism should be applicable to the global context as well. One could argue that this is what's happening in cases like (24).

- (24) I quit smoking a couple of years ago.

The hearer doesn't need to know that the speaker was a smoker before. They could just go with the speaker's assumptions and accept the presupposition. This is called (*global*) accommodation.

Some more examples from Geurts (1999:13):

- (25) a. We regret that children cannot accompany their parents to commencement exercises.
b. John lives in the third brick house down the street from the post office.
c. It has been pointed out that there are counterexamples to my theory.

In Satisfaction Theory, we can understand this as the same operation as local accommodation. In order to make sense of (24), for example, you first update the context with the information that the speaker used to be a smoker, and then update the resulting context with the at-issue meaning of (24).

Something like this is assumed by many, but whether the two types of accommodation should be captured by the same mechanism is a controversial issue.

2.3 The 'Proviso Problem'

Recall the problem of conditional presuppositions.

- (26) a. Mary flew to London and her sister picked her up.
b. If Mary flies to London, her sister will pick her up.

According to Satisfaction Theory, the presuppositions of these sentences are satisfied in contexts c such that for each $w \in c$ the following is the case: if Mary flies/flew to London, then she has a sister. But one usually takes (26) as presupposing that Mary has a sister.

Notice that this problem only arises with accommodation. If it is known that Mary has a sister, then it is also true that if she flew/flies to London, she has a sister, so the presupposition will be satisfied without a problem.

Based on this observation, it is sometimes suggested that (global) accommodation allows you to accommodate something more than what the semantic presupposition of the sentence requires Beaver (2001), Kadmon (2001), von Stechow (2008).

Roughly, the idea goes as follows: the semantic presupposition of these sentences is that if Mary flew/flies to London, then she has a sister. Minimally you only need to accommodate this conditional presupposition. However, it is weird to assume that Mary has a sister only if she goes to London, so you accommodate something more natural and stronger, that she has a sister.

Whether this is the right analysis of what's going on here is a hotly debated issue. We'll come back to it with Matt Mandelkern on 2 February.

Exercise: Geurts (1999) points out that (27) is a problem for the above analysis:

(27) John knows that if Mary flies to London, she has a sister.

Why is this a problem? (see also Pérez-Carballo (2009)).

3 Quantification

3.1 Assignment Functions and Variables

In order to deal with quantified sentences, Heim (1982, 1983) proposes to enrich the context with assignment functions. We take assignment functions to be partial functions from indices to individuals.⁴

- (28) A context c is a set of assignment-world pairs such that:
- $\{ w \mid \exists g[\langle g, w \rangle \in c] \}$ is the Stalnakerian Context Set;
 - for any $\langle g, w \rangle, \langle g', w' \rangle \in c$, $\text{dom}(g) = \text{dom}(g')$

Assignment functions keep track of *discourse referents* and their possible extensions (Karttunen 1971, Heim 1982). They are useful in account for pronominal anaphora (see Brasoveanu 2007, 2008, 2010, Chierchia 1995, Groenendijk & Stokhof 1991, Dekker 2012, Nouwen 2003, 2007, among many others). As (28b) says, all assignments in a context have the same domain. We call that common domain the domain of c , and denote it by $\text{dom}(c)$.

Sentences without variables are processed as before.

⁴Heim (1983) assumes that assignment functions are total. See Nouwen (2003, 2007), Dekker (2012) for arguments for making them partial.

$$(29) c[\text{it is raining}] = \{ \langle g, w \rangle \in c \mid \text{it is raining in } w \}$$

In FCS, variables (which pronouns and traces denote) play two roles: When a variable is in $\text{dom}(c)$, it gets possible referents via assignment functions in c . Pronouns and traces lexically require the index to be in $\text{dom}(c)$ as part of their presuppositions.

- (30) a. $c \in \text{dom}([\text{she}_5 \text{ cried}])$ iff $5 \in \text{dom}(c)$ and for each $\langle g, w \rangle \in c$, $g(5)$ is female in w
 b. Whenever defined, $c[\text{she}_5 \text{ cried}] = \{ \langle g, w \rangle \in c \mid g(5) \text{ cried in } w \}$

Indefinites, on the other hand, denote variables with new indices.⁵ We assume that the syntax gives the following LF with indices and variables:

- (31) a. $c \in \text{dom}([\text{a}^2 (x_2 \text{ boy}) (x_2 \text{ cried})])$ iff $2 \notin \text{dom}(c)$.
 b. Whenever defined, $c[\text{a}^2 x_2 \text{ boy } x_2 \text{ cried}] = \{ \langle g[2 \mapsto e], w \rangle \mid \langle g, w \rangle \in c \text{ and } e \text{ is a boy in } w \text{ and } e \text{ cried in } w \}$

Here $g[2 \mapsto e]$ is just like g except that $g[2 \mapsto e](2) = e$.

It is actually possible to define the CCP of a alone (or in other words, we can treat a as a 'sentence'):

- (32) a. $c \in \text{dom}([\text{a}^i])$ iff $i \notin \text{dom}(c)$.
 b. Whenever defined, $c[\text{a}^i] = \{ \langle g[i \mapsto e], w \rangle \mid \langle g, w \rangle \in c \text{ and } e \text{ is an individual} \}$

$$(33) \text{ Whenever defined, } c[\text{a}^i \phi \psi] = c[\text{a}^i][\phi][\psi]$$

3.2 Presupposition Projection Through Indefinites

Now let us see what happens when there's a presupposition trigger in the nuclear scope ψ , as in (34) from Heim (1983):

$$(34) A^1 x_1 \text{ fat man } x_1 \text{ was pushing his}_1 \text{ bike.}$$

The restrictor and nuclear scope are interpreted as follows.

- (35) a. $c \in \text{dom}([\text{x}_1 \text{ fat man}])$ iff $1 \in \text{dom}(c)$
 b. Whenever defined $c[\text{x}_1 \text{ fat man}] = \{ \langle g, w \rangle \in c \mid g(1) \text{ is a fat man in } w \}$
- (36) a. $c \in \text{dom}([\text{x}_1 \text{ was pushing his}_1 \text{ bike}])$ iff for each $\langle g, w \rangle \in c$, $1 \in \text{dom}(g)$ and $g(1)$ had a bike in w and $g(1)$ was male in w
 b. Whenever defined $c[\text{x}_1 \text{ was pushing his}_1 \text{ bike}] = \{ \langle g, w \rangle \in c \mid g(1) \text{ was pushing his bike in } w \}$

Then:

⁵Heim revises her view of indefinites in Heim (1991, 2011) with the idea of anti-presuppositions.

- (37) a. $c \in \text{dom}([a^1])$ iff $1 \notin \text{dom}(c)$
 b. $c \in \text{dom}([a^1])$ and $c[a^1] \in \text{dom}([x_1 \text{ fat man}])$ iff $1 \notin \text{dom}(c)$
 c. $c \in \text{dom}([a^1])$ and $c[a^1] \in \text{dom}([x_1 \text{ fat man}])$ and $c[a^1][x_1 \text{ fat man}] \in \text{dom}([x_1 \text{ was pushing his}_1 \text{ bike}])$ iff $1 \notin \text{dom}(c)$ and for each $\langle g, w \rangle \in c$, for each $\langle g[1 \mapsto e], w \rangle$ such that e is a fat man in w , e has a bike in w

The local context for the nuclear scope consists of those pairs $\langle g, w \rangle$ such that $g(1)$ is a fat man in w . This means that the Context Set of c only contain possible worlds where every fat man has a bike!

This is arguably too strong. Heim (1983) suggests that you perform local accommodation before computing the nuclear scope, which turns the presupposition of the nuclear scope into an at-issue meaning. Effectively, what is predicted is the same as:

- (38) A fat man owned a bike and was pushing it.

A similar problem arises with a presupposition triggered in the restrictor.

- (39) $A^1(x_1 \text{ man who was pushing his}_1 \text{ bike})(x_1 \text{ was tired})$.
 (40) a. $c \in \text{dom}([x_1 \text{ man who was pushing his}_1 \text{ bike}])$ iff for each $\langle g, w \rangle \in c$, $1 \in \text{dom}(g)$ and $g(1)$ had a bike in w
 b. Whenever defined $c[x_1 \text{ man who was pushing his}_1 \text{ bike}] = \{ \langle g, w \rangle \in c \mid g(1) \text{ was pushing his bike in } w \}$
 (41) a. $c \in \text{dom}([x_1 \text{ was tired}])$ iff $1 \in \text{dom}(c)$
 b. Whenever defined $c[x_1 \text{ was tired}] = \{ \langle g, w \rangle \in c \mid g(1) \text{ was tired in } w \}$

Then:

- (42) a. $c \in \text{dom}([a^1])$ iff $1 \notin \text{dom}(c)$
 b. $c \in \text{dom}([a^1])$ and $c[a^1] \in \text{dom}([x_1 \text{ man who was pushing his}_1 \text{ bike}])$ iff for each $\langle g, w \rangle \in c$, $1 \notin \text{dom}(g)$ and each individual e had a bike in w .

Again, this is too strong. Notice in particular the set of individuals include not just people but also chairs and desks, which are also required to own bikes here.

Heim's (1983) suggestion is that here too, you perform local accommodation, so before the update with the restrictor, you insert an additional update so that the presupposition will be satisfied:

- (43) $c[a^1][x_1 \text{ owns a bike}][x_1 \text{ man who was pushing his}_1 \text{ bike}]$

However, I think this solution is not satisfactory. Consider, for example, (44):

- (44) a. Mary doubts that a fat man is pushing his bike.

- b. Was a fat man pushing his bike?

Heim (1983) predicts no presuppositions for (44). We will discuss presupposition projection through quantificational expressions more on 9 February 2018.

3.3 Universal Quantifiers

Generalised quantifiers in dynamic semantics are a bit more convoluted (see Chierchia 1995, Van den Berg 1996, Nouwen 2003, 2007, Brasoveanu 2007, 2008, 2010). For example, we could analyse *every* as follows:⁶

- (45) a. $c \in \text{dom}([\text{every}^i \phi \psi])$ only if $i \notin \text{dom}(c)$
 b. Whenever defined, $c[\text{every}^i \phi \psi] = \left\{ \langle g, w \rangle \in c \mid \begin{array}{l} \{ g'(i) \mid \langle g', w \rangle \in c[a^i][\phi] \wedge g \leq g' \} \\ \subseteq \{ g''(i) \mid \langle g'', w \rangle \in c[a^i][\phi][\psi] \wedge g \leq g'' \} \end{array} \right\}$

- (46) $g \leq g'$ iff for each $i \in \text{dom}(g)$, $g(i) = g'(i)$.

- (47) Whenever defined, $c[\text{Every}^3 x_3 \text{ girl } x_3 \text{ cried}] = \{ \langle g, w \rangle \in c \mid \text{the set of girls in } w \text{ is a subset of girls who cried in } w \}$

What if the restrictor ϕ and/or nuclear scope ψ have presuppositions?

As you can see, you need to compute $c[a^i][\phi]$ and $c[a^i][\phi][\psi]$. Thus, the predictions are the same as in the case of indefinites: the presupposition of ϕ needs to be satisfied in c with respect to all individuals; the presupposition of ψ needs to be satisfied with respect to all individuals that made ϕ true.

For instance, (48) is predicted to presuppose that every student has a paper and will have their paper accepted by *L&P*.

- (48) Every student is aware that their paper will be accepted by *L&P*.

This prediction looks reasonable. On the other hand, the prediction for restrictors is wrong. E.g. (49) is predicted to presuppose that every individual, student or not, has a paper that will be accepted by *LI*.

- (49) Every student who is aware that their paper will be accepted by *LI* is happy.

3.4 Other Generalised Quantifiers

In general, you can describe the meaning of a generalised quantifier as follows.

- (50) a. $c[Q^i \phi \psi]$ is defined only if $i \notin \text{dom}(c)$

⁶(45) works because we don't allow information loss by random assignment on old variables (random assignment by a is only defined for new variables) (Nouwen 2003, 2007).

$$b. \text{ Whenever defined, } c[\mathbb{Q}^i \phi \psi] \\ = \left\{ \langle g, w \rangle \in c \mid \begin{array}{l} \mathbb{Q}(\{g'(i) \mid \langle g', w \rangle \in c[a^i][\phi] \wedge g \leq g'\}) \\ (\{g''(i) \mid \langle g'', w \rangle \in c[a^i][\phi][\psi] \wedge g \leq g''}) \end{array} \right\}$$

\mathbb{Q} here is a dynamic quantifier, and \mathbb{Q} is its static counterpart, which is a relation between two sets. The semantics of *every* above is an instance of this. *Most* looks (roughly) like (51).

$$(51) \text{ a. } c[\text{most}^i \phi \psi] \text{ is defined only if } i \notin \text{dom}(c) \\ b. \text{ Whenever defined, } c[\text{most}^i \phi \psi] \\ = \left\{ \langle g, w \rangle \in c \mid \frac{|\{g'(i) \mid \langle g', w \rangle \in c[a^i][\phi] \wedge g \leq g'\}|}{|\{g''(i) \mid \langle g'', w \rangle \in c[a^i][\phi][\psi] \wedge g \leq g''\}|} \gg \frac{1}{2} \right\}$$

According to analysis, the predictions about presupposition projection are the same for all dynamic generalised quantifiers, because in order to compute $c[\mathbb{Q}^i \phi \psi]$, you need to compute $c[a^i][\phi]$ and $c[a^i][\phi][\psi]$. Arguably, these predictions are not correct in the general case, especially for restrictors.

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