File Change Semantics

Elizabeth Coppock

University of Gothenburg

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Traditional familiarity theory of definiteness (Christopherson)

(1) A definite is used to refer to something that is already familiar at the current stage of the conversation. An indefinite is used to introduce a new referent.

Problem: Definites and indefinites are not always referring expressions.

(2) Every cat ate its food.
(2) John didn't see a cat.

Karttunen's "Discourse Referents"

Heim's theory: A defnite NP picks out a familiar discourse referent; an indefinite introduces a new discourse referent.

Advantages:
(4) John came, and so did Mary. One of them bought a cake.
"refers" to John or Mary, yet both are familiar.
(5) Everybody found a cat and kept it. It ran away.
(plus donkey-sentences –EEC)

What are discourse referents? Heim: File cards.

File-card semantics

A woman was bitten by a dog.

1	2
woman bitten by 2	dog bit 1

File-card semantics

A woman was bitten by a dog.
She hit him with a paddle.

1	2	3
woman bitten by 2 hit 2 with 3	dog bit 1 was hit by 1 with 3	paddle used by 1 to hit 2

File-card semantics

A woman was bitten by a dog.
She hit him with a paddle.
It broke in half.

1	2	3
woman bitten by 2 hit 2 with 3	dog bit 1 was hit by 1 with 3	paddle used by 1 to hit 2 broke in half

File-card semantics

A woman was bitten by a dog.
She hit him with a paddle.
It broke in half.
The dog ran away.

1	2	3
woman bitten by 2 hit 2 with 3	dog bit 1 was hit by 1 with 3 ran away	paddle used by 1 to hit 2 broke in half

Novelty-Familiarity-Condition

(7) For every indefinite, start a new card; for every definite, update a suitable old card.

Formal theory

- The grammar generates sentences on several levels of analysis including a level of ”logical form” (LF).
- Each LF is assigned a file change potential: a function from files to files.
- There is a system for assigning truth conditions to files.

Files and the World

"What does it take for a file to be true? To establish the truth of a file, we have to, so to speak, line up the sequence of cards in the file with a sequence of actual individuals, such that each individual fits the description on the corresponding card. Or, as I will put it, we have to find a sequence of individuals that satisfies the file."

"Depending on how many cards a file contains, it will take pairs, triples, quadruples, or what not to satisfy it, therefore I speak generally of 'sequences'. Technically, a sequence is a function from some subset of N (the natural numbers) into A (the domain of all individuals)."

Satisfaction and truth of files

In order to establish the truth of a file, we must find a sequence of individuals that satisfies it.

A sequence of individuals satisfies a file (in a possible world) if the first individual in the sequence fits the description on card number 1 in the file (according to what is true in the world), etc.

A file is true (a.k.a. satisfiable) in a possible world iff it has there is a sequence that satisfies it in that world.

Example

1	2	3
woman bitten by 2 hit 2 with 3	dog bit 1 was hit by 1 with 3 ran away	paddle used by 1 to hit 2 broke in half

World 1	**World 2**
Pug bit Joan	Fido bit Joan
Joan hit Pug with Paddle	Joan hit Fido with Paddle
Paddle broke in half	Paddle broke in half
Pug ran away	Fido ran away

	Sequence 1	**Sequence 2**	**Sequence 3**
1	Joan	Pug	Sue
2	Fido	Pug	Pug
3	Paddle	Paddle	Paddle

Some notation

Sat(F) (read: ”the satisfaction set of F”) is the set of sequences that satisfy file F.

(More formal definition of truth:
F is true if and only if Sat(F) $\neq \emptyset$)

Dom(F) (read “the domain of F”) is the set of card numbers used in file F.

A domain and a satisfaction set does not suffice to pick out a unique file. However, these are the only properties of files that are specified in this article.

Example

A woman was bitten by a dog.

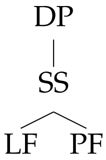
F1:

1	2
woman bitten by 2	dog bit 1

Sat(F1) = {⟨a1,a2⟩: a1 is a woman, a2 is a dog, and a2 bit a1 }
Dom(F1) = {1,2}

Logical Forms

The “T-model”:

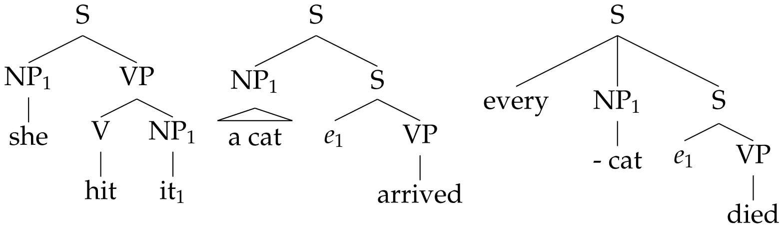


Logical Forms

Logical forms are disambiguated with respect to scope and anaphoric relations. LFs are derived by transformational rules. The rules depend on semantic category, and can distinguish at least between:

- variables: pronouns, empty NPs, indices on NPs with predicate heads
- predicates: verbs, nouns
- operators: *every*, negation

Logical forms



- Every NP in logical form carries a numerical index.
- Only variables occur in the argument positions of predicates.
- NPs that are not variables, i.e. those headed by prediates, are adjoined to their scopes and coindexed with the argument position they originate from.
- Operators are adjoined as sisters to their argument(s). Note that *a* and *the* are not operators. They have no semantic category.

File Change Potentials

An LF will be associated with a file change potential. If p is an LF and F is a file, then

$$F + p$$

is the file F' that result from updating F on account of p.

An update

F1:

1	2
woman bitten by 2	dog bit 1

Sat(F1) = {⟨a1,a2⟩: a1 is a woman, a2 is a dog, and a2 bit a1 }

Now we update with "she$_1$ hit it$_2$" to produce F2.

Sat(F2) = {⟨a1,a2⟩: ⟨a1,a2⟩ in Sat(F1) and ⟨a1,a2⟩ in Ext("hit") }
= {⟨a1,a2⟩: a1 is a woman, a2 is a dog, a2 bit a1, and a1 hit a2 }

Choosing indices

F1:

1	2
woman bitten by 2	dog bit 1

How did we know that it should be "she$_1$ hit it$_2$" and not:

(14a) She$_1$ hit it$_1$ ← violates "Disjoint reference"
(14b) She$_3$ hit it$_7$ ← violates Novelty/Familiarity Condition
(14c) She$_2$ hit it$_1$ ← need to take gender into account

Novelty/Familiarity Condition (formal version)

(15) Let F be a file, p an atomic proposition. Then p is appropriate with respect to F only if, for every noun phrase NP_i with index i that p contains:

- if NP_i is definite, then $i \in Dom(F)$
- and if NP_i is indefinite, then $i \notin Dom(F)$

Note: In order for (15) to be applicable in the intended way, we must generally assume that NPs in logical form are marked for the feature [+definite] or [-definite].

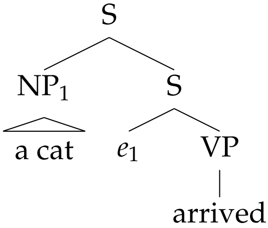
Appropriateness conditions

The Novelty/Familiarity Condition is a principle that constrains the choice of logical form relative to a given file. It determines when a logical form is appropriate with respect to a file. States an appropriateness condition.

"From the point of view of the task of assigning file change potentials to logical forms, we may take appropriateness conditions as delimiting the range of pairs ⟨F,p⟩ for which the file change operation F+p is defined. Unless p is appropriate with respect to F, there is no file change result F + p determined." (p. 234)

Updating with indefinites

(12b)



Start with the empty file F_0. Result should be:

Sat(F_0 + (12b)) = $\{\langle a_1 \rangle$: a_1 is a cat and a_1 arrived$\}$

We do it in two steps: add the cat, then say it arrived.

(16) Let F be a file, and let p be a molecular proposition whose immediate constituents are the propositions q and r (in that order). Then: Sat(F+p) = Sat((F+q)+r)

Update rules for atomic propositions

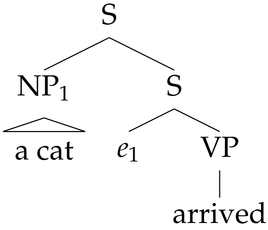
(18) Let F be a file, and let p be an atomic proposition that consists of an n-place predicate R and an n-tuple of variables whose indices are $i_1, \ldots, i_n$ respectively. Then:
$\text{Sat}(F{+}p) = \{a_N \cup a_M$ with domain $N \cup M : a_N \in \text{Sat}(F)$,
$M = \{i_1, \ldots, i_n\}$, and $\langle b_{i_1}, \ldots, b_{i_n} \rangle \in \text{Ext}(R)\}$

In other words:

- Take all assignments that satisfy F,
- Extend them as needed to cover all of the variables in the new sentence
- Eliminate them if the relation doesn't hold

Example

(12b)



$\text{Sat}(F_0 + [\text{a cat}]_1) = \{\langle b_1 \rangle : b_1 \text{ in Ext}(\text{"cat"})\}$

To incorporate "e_1 arrived", we apply (18) again.

(20) $\text{Sat}(F_0 + (12b))$
$= \text{Sat}\ ((F_0 + [\text{a cat}]_1) + [\ e_1 \text{ arrived}]\ )$
$= \{\langle b_1 \rangle : b_1 \in \text{Ext}(\text{"cat"}) \text{ and } b_1 \in \text{Ext}(\text{"arrived"})\ \}$

Truth with respect to a file

(21) Let F be a true file and p a logical form. Then p is:

true w.r.t. F	if F+p is true
false w.r.t. F	if F+p is false
truth-value-less w.r.t. F	if F+p is undefined

The Non-quantificational Analysis of Indefinites

Russell's analysis of (12b) *A cat arrived*:

$\exists x[\textsc{cat}(x) \wedge \textsc{arrived}(x)]$

Heim's analysis of (12b) *A cat arrived*:

$[\textsc{cat}(x) \wedge \textsc{arrived}(x)]$

There is no existential quantifier, but Heim's theory predicts existential truth-conditions. Proof: If F + (12b) is true, then (12b) is appropriate w.r.t. F and Sat(F+(12b)) is non-empty. The latter means that there is a sequence of individuals containing a cat that arrived.

Magic?

At first sight, one might have thought it impossible that an existential truth-condition can be predicted while assuming a quantifier-free logical form like (12b) or (24). But there was of course no magic involved in the proof I just gave. The truth-condition came out existential because the notion of truth of a file has, so to speak, existential quantification built into it: truth of a file was defined as there being at least one satisfying sequence. So my disagreement with the quantificational analysis of indefinites is not a disagreement about whether or not we understand statements with indefinites in them as existentially quantified. It is rather a disagreement as to what is to be held responsible for the existential force of such statements: the indefinite article itself, or rather the way in which files generally relate to the facts that verify them?

Negation

(35) Let F be a file, and let p be a molecular proposition whose immediate constitents are a negation operator and the proposition q. Then:

Sat(F+not q) =
$\{a_N \in$ Sat(F): there is no $b_M \supseteq a_N$ such that $b_M \in$ Sat(F+q)$\}$

In other words, we keep the assignments that cannot be extended in a way that satisfies q.