Formal Semantics and Sentence Meaning

Eva Maria Vecchi

Lexicon, Syntax, Semantics IIb: Modeling Meaning

May 7, 2020

1   Introduction

Formalizing the meaning of individual words is insufficient since Natural Language speakers do not speak in single-word, and specifically content word, utterances.

(1)   a.   Giving you these flowers means that I love you.
       b.   Those mountains ahead mean trouble.
       c.   He said that he would join us, be he didnt mean it.
       d.   When I say X, I mean Y.
       e.   *Tazza* means mug.

Further, formalizing word meaning runs into difficulty when handling function words (e.g. *or*, *not*, *by*, *if*), cross-linguistic inconsistencies (e.g. *thimble* (EN) vs. *Fingherhut* (DE)), creativity and semantic shift in idioms and metaphors (e.g. *kick the bucket*, *a grey area*), and paralinguistic features (e.g. gestures, facial cues).

So, what is meaning? Many linguists argue there is no answer to this, like the question "what is a number?" in mathematics (see e.g. J. D. Fodor, 1983). Therefore, linguists have focused on identifying the kinds of phenomena a theory of semantics must cover to reflect an English speaker's knowledge:

(2)   That a and b are **synonymous**:
       a.   My brother is a bachelor.
       b.   My brother has never been married.

(3)   That a **entails** b:
       a.   The anarchist assassinated the emperor.
       b.   The emperor is dead.

(4)   That a **contradicts** b:
       a.   My brother Sebastian has just come from Rome.
       b.   My brother Sebastian has never been to Rome.

(5)   That a **presupposes** b, as c does d:
       a.   The Mayor of Manchester is a woman.
       b.   There is a Mayor of Manchester.
       c.   I regret eating your sandwich.
       d.   I ate your sandwich.

(6)   That a and b are necessarily true, i.e. **tautologies**:
       a.   Ireland is Ireland.
       b.   Rich people are rich.

(7)   That a and b are necessarily false, i.e. **contradictions**:
       a.   ?He is a murderer but he's never killed anyone.
       b.   ?Now is not now.

(8)   That a and b are grammatically correct but nonsensical, or **semantically deviant**
       a.   Colourless green ideas sleep furiously.
       b.   Kim frightened sincerity.

We would like our semantic theory to predict and explain these intuitions and thus we use intuitions of this kind to evaluate semantic theories.

1.1 Semantic Productivity/Creativity: Compositionality

A basic starting point of generative grammar: there are infinitely many sentences in any natural language, and the brain is finite, so linguistic competence must involve some finitely describable means for specifying an infinite class of sentences. That is a central task of **syntax**.

Semantics: A speaker of a language knows the meanings of those infinitely many sentences, is able to understand a sentence he/she has never heard before or to express a meaning he/she has never expressed before. So for semantics also there must be a finite way to specify the meanings of the infinite set of sentences of any natural language.

A central principle of formal semantics is that the relation between syntax and semantics is compositional.

The Principle of Compositionality *The meaning of an expression is a function of the meanings of its parts and of the way they are syntactically combined.*

2 Formal/Truth-conditional Semantics

Formal semanticists say that a primary function of language is that it allows us to talk about the world around us. When communicating with others and in our own internal reasoning, we use language to describe, or model, facts and situations. From this perspective, understanding the meaning of an utterance is being able to match it with the situation it describes; hence describe how the symbols of language relate to reality.

Truth-conditional semantics attempts to do this by taking the external aspect (relation to the world) of meaning as basic. According to this approach, a proposition is true or false depending on the state of affairs that obtain in the world and the meaning of a proposition is its **truth conditions**. For example, *John is clever* conveys a true proposition if and only if John is clever. Of course, we are not interested in verifying the truth or falsity of propositions – we would get into trouble with examples like *God exists* if we tried to equate meaning with verification. Rather knowing the meaning of a proposition is to know what the world would need to be like for the sentence to be true (not knowing what the world actually is like). The idea is that the inferences that we make or equivalently the entailments between propositions can be made to follow from such a theory. Semantics which is based on truth-conditions is called **model-theoretic**.

2.1 Truth conditions

The "truth of a sentence" is a central notion in the definition of sense relations (2-8 above). The basic methodological principles of formal semantics are:

1. If *A* and *B* are sentences, and *A* is true and *B* false, then *A* and *B* do not have the same meaning. (Cressewell's "Most Certain Principle")

2. If a person knows the meaning of a sentence, then he or she also know the necessary and sufficient conditions for the truth and falsity of this sentence.

3. Suppose a person knows the necessary and sufficient conditions for the truth and falsity of a sentence. Then this person knows the meaning of this sentence.

3 Propositional Logic

- Meaning of a clause: truth conditions $\longrightarrow$ determines **truth value**

    - Bivalent interpretation: Every sentence is either true or false ("tertium non datur"), but not both.

    - Truth values: "True" and "False" ("T" and "F", "1" and "0", "$\top$" and "$\bot$")

- for certain syntactic combinations: **Compositionality of truth values**

(9)   The sentence (a) is true iff both (b) and (c) are true, false otherwise.
    a.   The power is on and the outside temperature is below freezing point.
    b.   The power is on.
    c.   The outside temperature is below freezing point.

(10)   The sentence (a) is true iff at least one of (b) and (c) are true, false otherwise.
    a.   The grapes are too high or you are too short.
    b.   The grapes are too high.
    c.   You are too short.

(11)   The sentence (a) is true iff (b) is false, and vice versa.
    a.   I do not have the ace of hearts.

b. I have the ace of hearts

(12) The sentence (a) is false if (b) is true and (c) is false, otherwise true.

    a. If x is a prime number larger than 2, it is an odd number.

    b. x is a prime number.

    c. x is an odd number.

(13) The sentence (a) is true if both (b) and (c) are true or both (b) and (c) are false, otherwise it is false.

    a. The light is on if and only if the switch is up.

    b. The light is on.

    c. The switch is up.

Propositional Logic:

- Simple formal language

- disregards internal structure of simple clauses

- conjunction, disjunction, negation, implication and equivalence are only syntactic operations

- Compositionality of truth values

> **Definition 1 (Syntax of propositional logic):** There is an inifinite number of **propositional variables** $p, q, r, p', p'', q_1, ...$
>
> 1. Every propositional variable is a formula.
>
> 2. If φ is a formula, then $\neg\varphi$ ("not φ") is a formula.
>
> 3. If φ and ψ are formulas, $\varphi \wedge \psi$ ("φ and ψ") is a formula.
>
> 4. If φ and ψ are formulas, $\varphi \vee \psi$ ("φ or ψ") is a formula.
>
> 5. If φ and ψ are formulas, $\varphi \rightarrow \psi$ ("φ implies ψ") is a formula.
>
> 6. If φ and ψ are formulas, $\varphi \leftrightarrow \psi$ ("φ if and only if ψ") is a formula.
>
> 7. Nothing else is a formula.

Bracketing conventions

- Redundant brackets are optional.

- Connectives are right-associative ($p \rightarrow q \rightarrow r$ means $(p \rightarrow (q \rightarrow r))$)

- $\neg$ takes precedence over $\wedge$ takes precedence over $\vee$ takes precedence over $\rightarrow$ takes precedence over $\iff$

4 Assignment

Due Tuesday, May 12, 2020

- Give one own example for each of the sense relations given in Example (2)-(8) of the handout.

- Read T. Briscoe (2011) Introduction to Formal Semantics for Natural Language, Sections 1-3. Do exercises 1,3-5 from Section 3.1.

4.1 Additional Readings

- B. H. Partee (1999). Semantics in R.A. Wilson and F.C. Keil, eds., *The MIT Encyclopedia of the Cognitive Sciences*. Cambridge, MA: The MIT Press. 739-742.

- Partee, B. H. (2011). Formal semantics: Origins, issues, early impact. Baltic International Yearbook of Cognition, Logic and Communication, 6(1), 13.

- Chierchia & McConnell-Ginet (2000). Meaning and Grammar: An Introduction to Semantics. MIT Press. pp 170-203[1]

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[1]Check university library