EBERHARD KARLS
UNIVERSITÄT
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Faculty of Philosophy
General Linguistics

Semantics & Pragmatics SoSe 2021

Lecture 19: Summary Pragmatics

13/07/2021, Christian Bentz

Mock Exam

- The Mock Exam is held on **15.07.2021** (this thursday) between **12.00 and 14.30**.
- You find the link to it on the **moodle page** of the course.
- You will be able to **lock in between 12.00 and 12.30**. If you lock in before 12.30 you will receive two hours (120 mins) to work on it. 14.30 is a hard deadline.
- The mock exam is going to be discussed in the tutorials next week.

Q&A

Tutorial 9: Discourse Representation Theory

- *Ex. 1 (b): Is it possible to have the universal quantifier before* $[_2$ *x: elephant(x)*$]$ *instead of placing it in the middle?*

  Sentence: "Every elephant likes a deer."
  DRS Solution: $[_1$ *:* $[_2$ *x: elephant(x)*$]$ *(*$\forall$*x)* $[_3$ *y: deer(y), likes(x,y)*$]]$

  – No, remember from the syntactic clauses of DRT that the structure is defined here as $K(Qx)K'$, where Q is a quantifier. So it has to occur between the DRSs.

Q&A

Tutorial 9: Discourse Representation Theory

- *Ex. 1 (b): Can we use existential quantifier for (a deer)?*

  Sentence: "Every elephant likes a deer."
  DRS Solution: $[_1$ *:* $[_2$ *x: elephant(x)*$]$ *(∀x)* $[_3$ *y: deer(y), likes(x,y)*$]]$

  – No, remember that in DRT we treat "a dear" and "the dear" the same, namely, they would be represented by "y: deer(y)" in the DRS. In fact, this can probably be read as *there exists an individual y, and this individual is a deer*. The only case (at least in our lectures) when we need the existiential quantifier is with "some", i.e. "some farmer owns a donkey".

Overview

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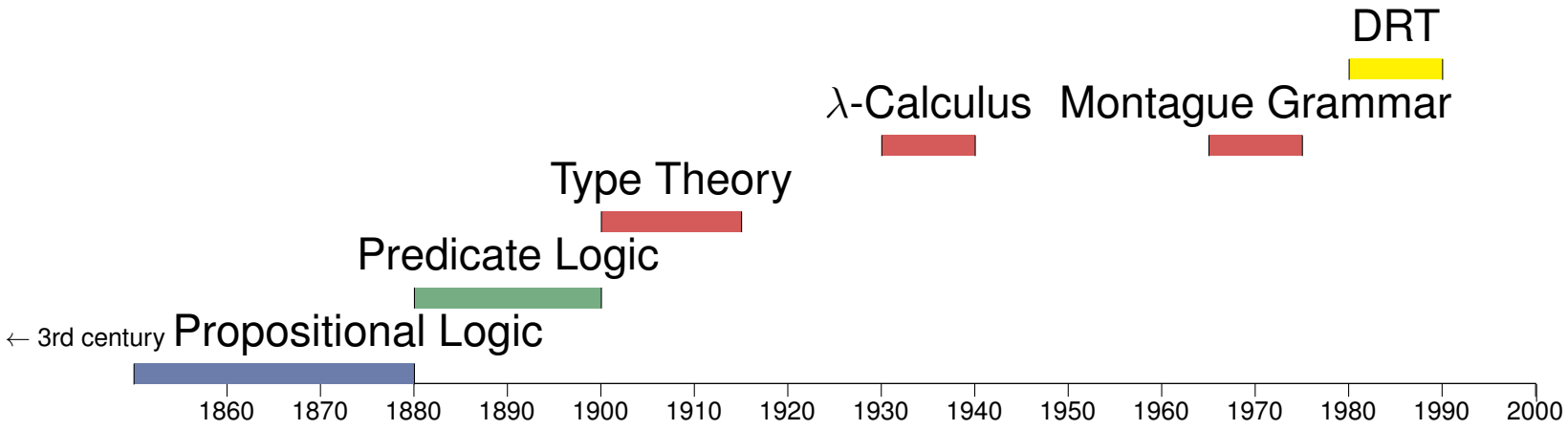
Lecture 14: Discourse Representation Theory I

Historical Background

"In the early 1980s, **Discourse Representation Theory (DRT)** was introduced by Hans Kamp as a theoretical framework for dealing with issues in the semantics and pragmatics of anaphora and tense (Kamp 1981); a very similar theory was developed independently by Irene Heim (1982)."

Geurts & Beaver (2007), p. 1.



Differences to Classical Formal Semantics

Some **differences** to classical formal semantic frameworks, e.g. standard predicate logic and type-theoretic logic, include:

- DRT deals with interpretations **not only of individual sentences**, but of **discourse structures**.

  → **Discourse** Representation Theory

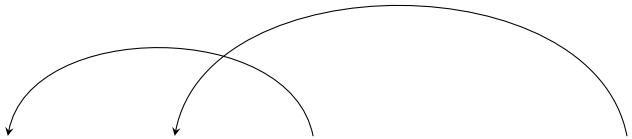
- It is a **mentalist and representationalist** theory of interpretation of natural language structures, i.e. it aims to explicitely represent in its formulations what is represented in the human mind when interpreting natural language.

  → Discourse **Representation** Theory

Geurts & Beaver (2007), p. 1.

Anaphora Resolution

The problem of how hearers are able to **"resolve" anaphora**, e.g. to know which **referent (antecedent)** of the discourse a **pronoun (consequent)** is referring back to, has received attention from both syntacticians and semanticists over the course of centuries. It has resisted straightforward explanations.



If Bambi$_i$ gives Maya$_j$ flowers$_k$ she$_j$ will like them$_k$.

Note: While anaphora resolution across sentences might be considered outside the scope of classical syntax and semantics – as these theories mostly deal with single sentences – the same problems also occur within sentences.

Discourse Representation Structures

A DRS consists of **two major parts**:

1. a set of **discourse referents**,
2. a set of so-called **DRS-conditions** which capture the information about referents that has accummulated over the discourse.

(1) John chased Jumbo.
[x, y: John(x), Jumbo(y), chased(x,y)]

(2) John chased a donkey.
[x, y: John(x), donkey(y), chased(x,y)]

(3) A farmer chased a donkey.
[x, y: farmer(x), donkey(y), chased(x,y)]

Note: The colon ':' delimits the set of discourse referents from the set of discourse conditions.

Merging Operation

Beyond single sentences (or parts of sentences) discourse structures can be built also for consecutive sentences by **merging** their DRSs using the $\oplus$**-operator**, which is defined as their pointwise union from a set-theoretic perspective.

(4) A farmer chased a donkey.
[x, y: farmer(x), donkey(y), chased(x,y)]

(5) He caught it.
[v, w: caught(v, w)]

Geurts & Beaver (2007), p. 7.

Note: The discourse referents of the second sentence are here underlined to indicate that they are in need of antecedents. Geurts & Beaver (2007) do not further explain according to which rules exactly the underlined discourse referents (v, w) are matched with the discourse referents in the former DRS (x, y). In English, this could be done, for instance, via grammatical gender and/or word order.

Example

[x, y: farmer(x), donkey(y), chased(x,y)] $\oplus$ [v, w: caught(v, w)] =

[x, y, v, w: farmer(x), donkey(y), chased(x,y), caught(v, w)] =

[x, y, v, w: v=x, w=y, farmer(x), donkey(y), chased(x,y), caught(v,w)] =

[x, y: farmer(x), donkey(y), chased(x,y), caught(x,y)]

- The first line is just the original DRSs connected with the $\oplus$-operator.
- In the the second line, all discourse referents which are not already represented in the former DRS are added to the set of discourse referents, and likewise for the discourse conditions (pointwise union).
- In the third line, discourse conditions are added (equations) to model the mapping of antecedents to consequents.
- In the last line, these are then “resolved”, i.e. replaced by the original discourse referents x and y.

Complex DRS Conditions: Negation

The above example deals with **simple, i.e. non-embedded DRS conditions**. However, there are various natural language scenarios that require more **complex DRS conditions**, i.e. **embedded** DRS conditions. One such example is **negation**.

(6) John doesn't have a donkey.
[$_1$ x: John(x), ¬[$_2$ y: donkey(y), owns(x,y)]]

(7) It is grey.
[z: grey(z)]

Geurts & Beaver (2007), p. 7-8.

Note: The negation here scopes over *owns a donkey*, not over *John*. This scope is reflected in the embedded DRS.

Complex DRS Conditions: Conditionals

Similar to negation, **conditionals (material implication)** also gives rise to complex, i.e. embedded DRS structures.

(8) If John owns a donkey, he likes it.
$[_1$: $[_2$ x, y: John(x), donkey(y), owns(x,y)] $\rightarrow$ $[_3$ $\underline{v}$, $\underline{w}$: likes(v,w)]]

Note: Geurts & Beaver (2007), p. 8 put *John(x)* outside of $[_2 \ldots]$. However, it is unclear why *John(x)* would not belong to the antecedent of the conditional. In fact, Kamp (2016), p. 13 puts it inside $[_2 \ldots]$. We follow Kamp (2016) here. As to accessibility: The discourse referents x and y are accessible to v and w as before in the case of the conditional.

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Lecture 15: Discourse Representation Theory II

Formal Definition

"DRSs are **set-theoretic objects** built from **discourse referents** [the set U] and **DRS-conditions** [the set Con]."

(i) A DRS K is a pair $\langle U_K, Con_K \rangle$, where U_K is a set of discourse referents, and Con_K is a set of DRS-conditions.

(ii) If P is an n-place predicate, and $x_1, \ldots, x_n$ are discourse referents,[1] then $P(x_1, \ldots, x_n)$ is a DRS condition.

(iii) If x and y are discourse referents, then $x{=}y$ is a DRS-condition.

(iv) If K and K' are DRSs, then $\neg K$, $K \rightarrow K'$, and $K \vee K'$ are DRS-conditions.

(v) If K and K' are DRSs and x is a discourse referent, then $K(\forall x)K'$ is a DRS-condition.

Geurts & Beaver (2007), p. 12.

[1] In the actual examples, Geurts & Beaver (2007) do not use variable x with indeces but rather x, y, z, etc.

Clause (i): DRS Basic Structure

(i) A DRS K is a pair $\langle U_K, Con_K \rangle$, where U_K is a set of discourse referents, and Con_K is a set of DRS-conditions.

(9) John chased Jumbo.
[x, y: John(x), Jumbo(y), chased(x,y)]

(10) John chased a donkey.
[x, y: John(x), donkey(y), chased(x,y)]

(11) A farmer chased a donkey.
[x, y: farmer(x), donkey(y), chased(x,y)]

(12) John doesn't have a donkey.
[$_1$ x: John(x), ¬[$_2$ y: donkey(y), owns(x,y)]]

Clause (iv): Complex Conditions

(iv) If K and K' are DRSs, then $\neg K$, $K \rightarrow K'$, and $K \vee K'$ are DRS-conditions.

(13) John doesn't own a donkey.
$[_1$ x: John(x), $\neg[_2$ y: donkey(y), owns(x,y)]]

(14) If John owns a donkey, he likes it.
$[_1$: $[_2$ x, y: John(x), donkey(y), owns(x,y)] $\rightarrow$ $[_3$: likes(x,y)]]

(15) John owns a donkey or a horse.
$[_1$ x: John(x), $[_2$ y: donkey(y), owns(x,y)] $\vee$ $[_3$: horse(y), owns(x,y)]]

Note: In the last example involving disjunction, we follow Simons (1996), p. 251, who argues to deal with disjunction by assuming *just one entity y* which is either a donkey or a horse. Also, *John(x)* here has to be *outside* of the two DRSs connected by disjunction.

Clause (v): Quantification

(v) If K and K' are DRSs and x is a discourse referent, then $K(\forall x)K'$ is a DRS-condition.

(16) Every farmer who owns a donkey, likes it.
$[_1 : [_2$ x, y: farmer(x), donkey(y), owns(x,y)] $(\forall$x) $[_3 :$ likes(x,y)]]

(17) Some farmer who owns a donkey, likes it.
$[_1 : [_2$ x, y: farmer(x), donkey(y), owns(x,y)] $(\exists$x) $[_3 :$ likes(x,y)]]

Note: While in clause (v) Geurts & Beaver (2007) only define the case of the universal quantifier, at another point they state: "[...] a condition of the form $K(Qx)K'$, where Q may be any quantifier [...]", which suggests that the same definition holds for the existential quantifier.

Merging of DRSs

Given the set-theoretic definition of DRSs, **merging** of two (or more) DRSs (here K and K') is defined as their **pointwise union** ($\oplus$) such that we have

$$K \oplus K' = \langle U_K \cup U_{K'}, Con_K \cup Con_{K'} \rangle. \quad (1)$$

(18) A farmer chased a donkey. He caught it.
[x, y: farmer(x), donkey(y), chased(x,y)] $\oplus$ [v, w: caught(v, w)] =
[x, y, v, w: farmer(x), donkey(y), chased(x,y), caught(v,w)];

such that

$U_K \cup U_{K'} = \{x, y, v, w\}$
$Con_K \cup Con_{K'} = \{$farmer(x), donkey(y), chased(x,y), caught(v,w)$\}$

Merging of DRSs

The way merging is defined in DRT it follows that there is "no principled distinction between **(clausal) conjunction** and **sentence concatenation**." Therefore, in the syntax of the DRT language, we do not need a definition involving logical "and" ($\wedge$).

Geurts & Beaver (2007), p. 12.

(19) A farmer chased a donkey. He caught it.

(20) A farmer chased a donkey **and** he caught it.

Both natural language sentences are equally represented by the DRSs repeated from above:

(21) [x, y: farmer(x), donkey(y), chased(x,y)] $\oplus$ [v, w: caught(v, w)] $=$
[x, y, v, w: farmer(x), donkey(y), chased(x,y), caught(v,w)]

Accessibility: Formal Definition

"**Accessibility** is a relation between DRSs that is **transitive**[2] and **reflexive**,[3] i.e. it is a preorder. More in particular, it is the smallest preorder for which the following holds, for all DRSs K, K', and K'': if Con_K contains a condition of the form ...

- $\neg K'$, then K is accessible to K',
- $K' \vee K''$, then K is accessible to K' and K'',[4]
- $K' \rightarrow K''$, then K is accessible to K' and K' is accessible to K'',
- $K'(\forall x)K''$, then K is accessible to K' and K' is accessible to K''."

Geurts & Beaver (2007), p. 13.

[2] If a DRS K is accessible to K', and K' is accessible to K'', then K is also accessible to K'', but not the other way around.

[3] Every DRS is accessible to itself.

[4] But note that in this particular case of logical "or", K' is not accessible to K''.

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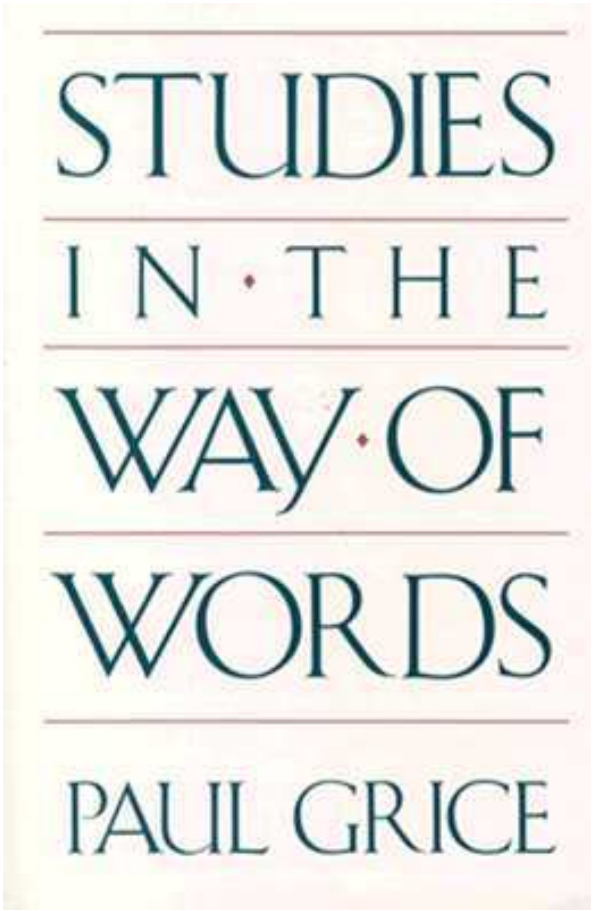
Lecture 16: Implicature

Historical Overview

Grice, Paul (1975). *Studies in the way of words.* Cambridge, Massachusetts: Harvard University Press.

"[...] while it is no doubt true that the formal devices [of formal semantic frameworks] are especially amenable to systematic treatment by the logician, it remains the case that there are very many **inferences and arguments, expressed in natural language and not in terms of these devices, which are nevertheless valid**. [...] I shall therefore inquire into the general conditions that, in one way or another, apply to conversation as such [...]"

Grice (1975), p. 23-24.



Grice's Maxims

(5) **The Cooperative Principle** (Grice 1975: 45)
Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged.

(6) **The Maxims of Conversation** (Grice 1975: 45–46)
QUALITY: Try to make your contribution one that is true.
1. Do not say what you believe to be false.
2. Do not say that for which you lack adequate evidence.

QUANTITY:
1. Make your contribution as informative as is required (for the current purposes of the exchange).
2. Do not make your contribution more informative than is required.

RELATION (or RELEVANCE): Be relevant.

MANNER: Be perspicuous.
1. Avoid obscurity of expression.
2. Avoid ambiguity.
3. Be brief (avoid unnecessary prolixity).
4. Be orderly.

Kroeger (2019), p. 142.

Failure to Fulfill a Maxim

There are different ways in which a participant of a communicative interaction might fail to fullfill a given maxim:

- They might **quietly violate a maxim**; in some cases, they will be liable to mislead.
- They might **opt out** from adhering to either the maxim, or the cooperation principle more generally (or both).
- They might be faced by a **clash**, i.e. it is impossible to adhere to one maxim without not adhering to another, e.g. a clash between Quality and Quantity.
- They might **flout** a maxim, that is obviously failing to fulfill it. If none of the above ways of failure to fulfill a maxim seems relevant, the hearer has to take this last possibility into account.

Grice (1975), p. 30.

Conversational Implicature

Conversational implicatures are a type of *pragmatic inference* about *what is said* by the speaker (literal meaning) in relation to what they actually *intend to convey* (communicative intention).

(22) A: Can you tell me where the post office is?
B: I'm a stranger here myself.

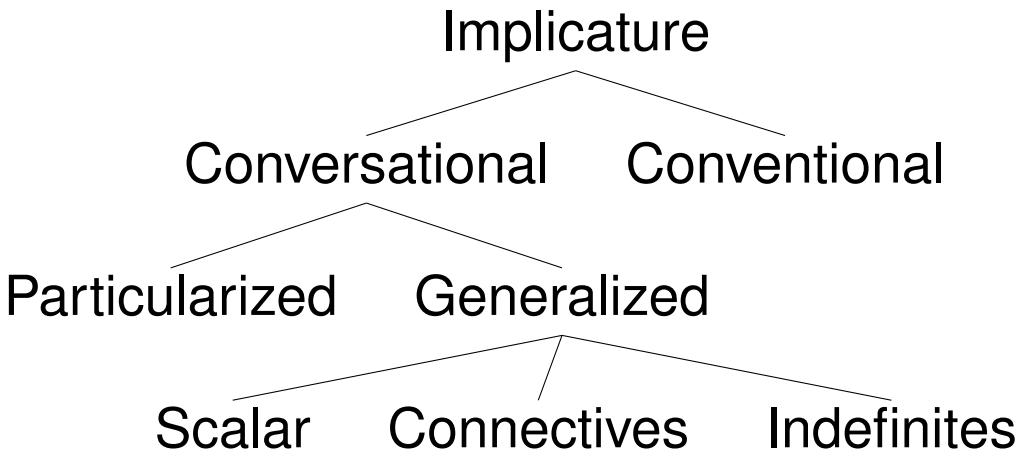
Pragmatic inference by A:

- I assume that B is participating in a *rational conversation*, i.e. adhering to the *cooperative principle* and the *maxims* (if possible).
- B seems to be violating the maxim of relevance.
- I assume we both know (it is part of our common ground) that strangers are unlikely to know the locations of particular places.
- I come to the pragmatic inference that the conversational implicature of B's statement is a more polite way of saying: "No, I cannot."

Kroeger (2019), p. 143.

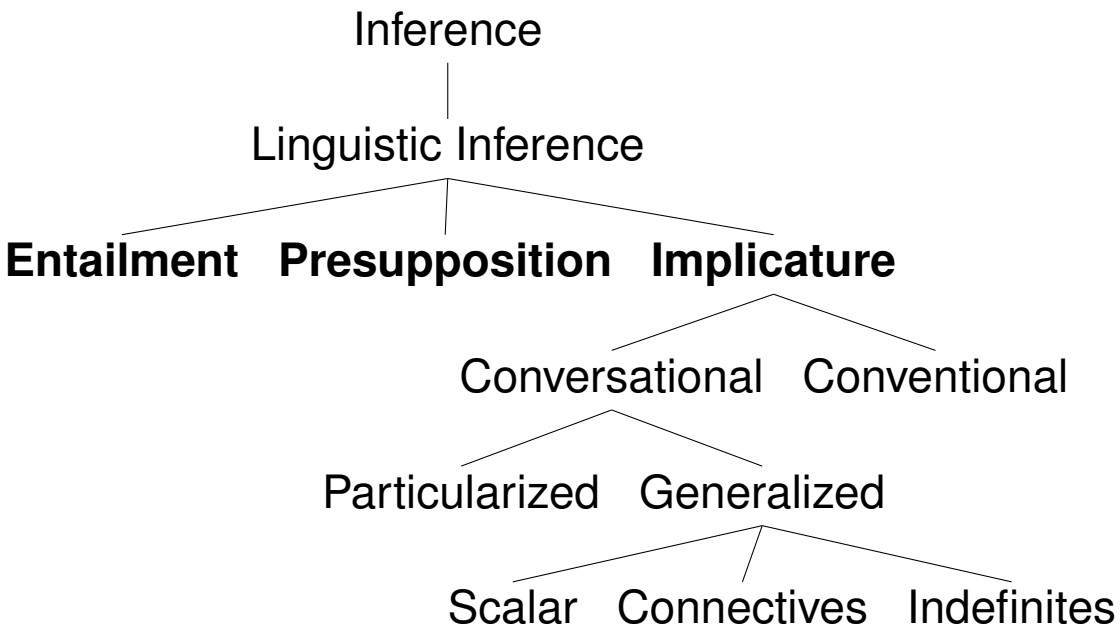
Types of Implicature

The following types of implicature are discussed in Kroeger (2019), p. 146-147.



Entailment, Presupposition, and Implicature

Given that we have established the difference between linguistic and non-linguistic inferences, **implicature** is one of several possible **linguistic inferences**. The others we will discuss are **entailment** and **presupposition**.



Entailment

"**Entailment** is a type of [linguistic] inference. We say that proposition p "entails" proposition q if p being true **makes it certain** that q is true as well."

Entailments thus require that:

1. whenever *p* is true, it is logically necessary that *q* is also true;
2. whenever *q* is false, it is logically necessary that *p* is also false;
3. these relations follow from the meanings of *p* and *q*, independent of the context of utterance.

Kroeger (2019), p. 36-38.

Criteria and Tests

In the following, we establish a **battery of overall five tests**, which can be used to distinguish entailments from implicatures (and presuppositions in the next step).

Kroeger (2019), p. 151 pp.

	Entailment	Conversational Implicature[5]
a. Cancellable[6]	NO	YES
b. Suspendable	NO	YES
c. Reinforceable	NO	YES
d. Negation	NO	NO
e. Question	NO	NO

[5]Note that here only *conversational implicature* is included, as it is unclear whether *conventional implicatures* will behave the same, or whether these would rather fall with presuppositions.

[6]Also called *defeasible*.

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Lecture 17: Presupposition

Historical Background

"[...] There is more literature on presupposition than on almost any other topic in pragmatics. [...] The volume of work is in part accounted for by a **long tradition of philosophical interest** [...] In addition presupposition was a **focal area in linguistic theory during the period 1969-76**, because it raised substantial problems for almost all kinds of (generative) linguistic theories [...]"

Levinson (1983), p. 167.

Frege's View on Presupposition

"If anything is asserted there is always an obvious presupposition[7] that the **simple or compound proper names used have a reference**. If one asserts 'Kepler died in misery', there is a presupposition that the name 'Kepler' designates something."

Levinson (1983), p. 169 citing Frege (1892), p. 69.

(23) Kepler died in misery.
PRESUPPOSITION: The name 'Kepler' denotes an individual.

(24) Kepler did *not* die in misery.
PRESUPPOSITION: The name 'Kepler' denotes an individual.

(25) *After* the separation of Schleswig-Holstein from Denmark, ...
PRESUPPOSITION: Schleswig-Holstein separated from Denmark.

[7] Frege used the German term *Voraussetzung* here.

Formal Definition

"A statement A presupposes a statement B iff:

(i) if A is true, then B is true,

(ii) if A is false, then B is [still] true."

Levinson (1983), p. 175, citing Strawson (1952).

(26) Statement A: Kepler died in misery.
PRESUPPOSITION B: The name 'Kepler' denotes an individual.

(27) Statement $\neg A$: Kepler did *not* die in misery.
PRESUPPOSITION B: The name 'Kepler' denotes an individual.

Presupposition Triggers

Over the years, a large number of **presupposition triggers** have been identified (for English). These include but are not limited to:

(a) Definite descriptions:
- definite noun phrases
- possessive phrases
- restrictive relative clauses

(b) Factive predicates

(c) Implicative predicates

(d) Aspecutal predicates

(e) Temporal clauses

(f) Counterfactuals

(g) Comparisons

(h) Scalar terms

Kroeger (2019), p. 43.

Tests: Presuppositions

The tests relevant to distinguish **entailments** and **conversational implicatures** from **presuppositions** are mainly the *Negation* and the *Question Test*.

Kroeger (2019), p. 152.

	Entailment	Conversational Implicature	Presupposition
a. Cancellable	NO	YES	sometimes[8]
b. Suspendable	NO	YES	sometimes
c. Reinforceable	NO	YES	NO
d. Negation	NO	NO	YES
e. Question	NO	NO	YES

[8] According to Kroeger (2019), p. 152, some presuppositions seem to be cancellable, "but only if the clause containing the trigger is negated. Presuppositions triggered by positive statements are generally not cancellable."

The Negation-Test

If the inference is **preserved under negation**, then it is said to pass the negation test.

(28) John did *not* kill the wasp.
INFERENCE: #The wasp died.
(preserved under negation: NO)

(29) B: There is *no* garage around the corner.
INFERENCE: #You can buy petrol there.
(preserved under negation: NO)

(30) John does not regret that he lied.
INFERENCE: John lied.
(preserved under negation: YES)

Test Summary

We then summarize the test results for each inference and compare it to the test-template (in the table above) to decide if it falls in either category.

(31) John killed the wasp.
INFERENCE: The wasp died.
_

cancellable: NO
suspendable: NO
reinforceable: NO
preserved under negation: NO
preserved in question: NO

→ **entailment**

(32) A: I ran out of petrol.
B: There is a garage around the corner.
INFERENCE: One can buy petrol there.

cancellable: YES
suspendable: YES
reinforceable: YES
preserved under negation: NO
preserved in question: NO

→ **conversational implicature**

(33) John regrets that he lied.
INFERENCE: John lied.
_

cancellable: NO
suspendable: NO?
reinforceable: NO
preserved under negation: YES
preserved in question: YES

→ **presupposition**

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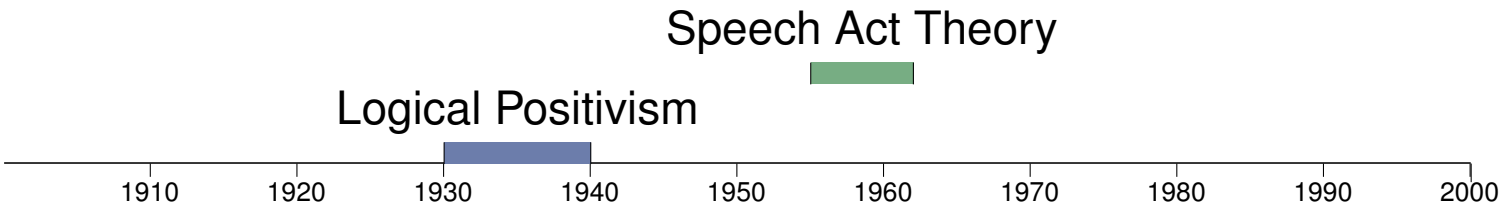
Lecture 18: Speech Acts

Historical Background

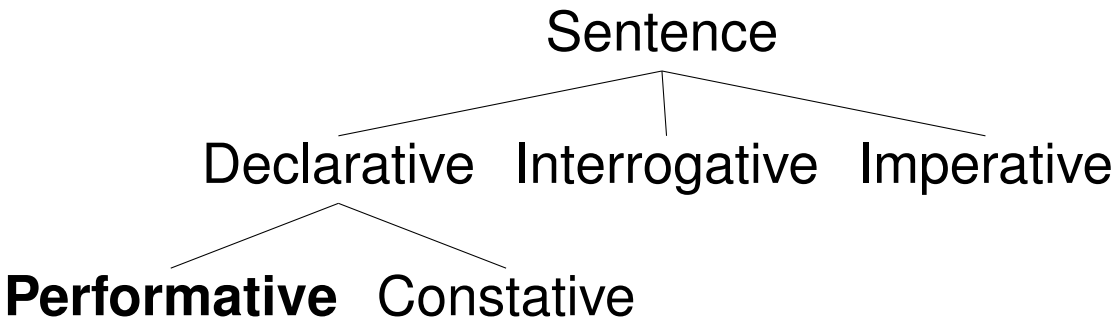
"[...] In the 1930 there flourished what can now be treated as a philosophical excess, namely a the doctrine of **logical positivism**, a central tenet of which was that unless a sentence can, at least in principle, be *verified* (i.e. tested for its truth or falsity), it was strictly speaking *meaningless*."

Levinson (1983), p. 227.



Performatives

Even if we stay in the domain of *declarative sentences*, there are certain sentences for which we cannot straightforwardly assign a truth value. They are not just used to *say* something about the world, but to actually *do* something, i.e. actively change the world. This type of declaratives is called **performatives** by Austin (1962).



Performatives: Examples

Austin's own examples:

(34) 'I do (take this woman to be my lawful wedded wife)' – as uttered in the course of the marriage ceremony.

(35) 'I name this ship the *Queen Elizabeth*' – as uttered when smashing the bottle against the stem.

(36) 'I give and bequeath my watch to my brother' – as occurring in a will.

(37) 'I bet you sixpence it will rain tomorrow.'

Austin (1962), p. 5.

Further examples:

(38) I hereby sentence you to 10 years in prison.

(39) I now pronounce you man and wife.

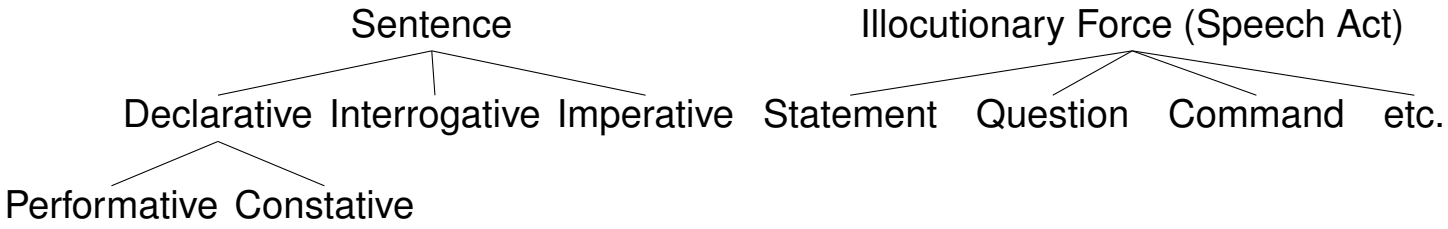
(40) I declare this meeting adjourned.

Kroeger (2019), p. 181.

Speech Acts

"We are attuned in everyday conversation not primarily to the sentences we utter to one another, but to the **speech acts** that those utterances are used to perform: *requests*, *warnings*, *invitations*, *promises*, *apologies*, *predictions*, and the like."

Green (2017).



Note: This distinction between *types of sentences* and *types of illocutionary forces/ speech acts* is mostly not strictly adhered to. This is apparent also in Kroeger (2019), p. 181: "Austin called this special class of declarative sentences performatives. He argued that we need to recognize performatives as a new class of speech acts [...] in addition to the commonly recognized speech acts such as statements, questions, and commands.

Three Parts of Speech Acts

According to Austin, there are three major subparts when performing a speech act:

1. **Locutionary Act**: The act of performing an utterance (phonetically and grammatically).
2. **Illocutionary Act**: The act of performing a *statement*, *question*, *command*, etc. by means of its conventional *force* (i.e. what is the locutionary act used for?)
3. **Perlocutionary Act**: The act of effecting the audience in a particular way.

Note: The Latin word *locutio* can mean “speech, speaking, phrase, pronunciation” (https://en.pons.com/translate/latin-german/locutio).

Example

(41) A to B: You can't do that.

SPEECH ACT performed by A:

LOCUTIONARY ACT: Production and pronunciation of the above sentence (in speech, writing or sign), given knowledge of the vocabulary and grammar of English, and the referent of *you*.[9]

ILLOCUTIONARY ACT: Protest against B doing sth., commanding B not to do sth.[10]

PERLOCUTIONARY ACT: Stopping B, Annoying B, etc.[11]

Austin (1962), p. 102.

[9] Austin would paraphrases this as "He said to me ...".
[10] Austin would paraphrase this as "He protested against my doing it".
[11] Austin would paraphrase this as "He stopped me, annoyed me, etc. ...".

Direct Speech Act

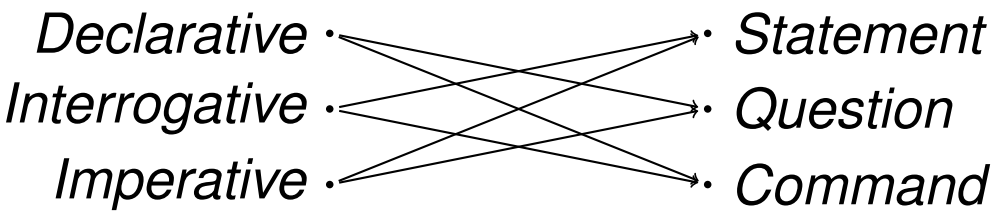
We have a **direct speech act** if the type of sentence (grammatical form) **matches the type of illocutionary force** (according to general expectation).

Declarative ⟶ *Statement*
Interrogative ⟶ *Question*
Imperative ⟶ *Command*

Indirect Speech Act

"We might define an **indirect speech act** (following Searle 1975) as an utterance in which one illocutionary act (the **primary act**) is intentionally performed by means of the performance of another act (the **literal act**). In other words, it is an utterance whose **form does not reflect the intended illocutionary force**."

Kroeger (2019), p. 186.



Examples: Indirect Speech Acts

(42) I want you to leave now. (Declarative)
ILLOCUTIONARY FORCE: Giving a command.

(43) I would like to have a cup of tea, please. (Declarative)
ILLOCUTIONARY FORCE: Request for tea.

(44) Can you pass me the salt? (Interrogative)
ILLOCUTIONARY FORCE: Command (rather than request for information).

(45) Isn't this a beautiful day? (Interrogative)
ILLOCUTIONARY FORCE: Statement (i.e. rhetorical question, which is not necessarily a request for information).

(46) Tell me the way to the train station! (Imperative)
ILLOCUTIONARY FORCE: Request for Information/Question.

(47) Look how blue the sky is! (Imperative)
ILLOCUTIONARY FORCE: Statement.[12]

[12] Thanks to Tanja Heck for the last two examples.

Summary

Formal Semantics

Natural Language	(M)PL	FOL	SOL	TL
John smokes.	p	Sj	Sj	S(j)
John smokes and drinks.	$p \wedge q$	$Sj \wedge Dj$	$Sj \wedge Dj$	$S(j) \wedge D(j)$
Jumbo likes Bambi.	r	Ljb	Ljb	L(b)(j)
Every man walks.	p_1	$\forall x(Mx \rightarrow Wx)$	$\forall x(Mx \rightarrow Wx)$	$\forall x(M(x) \rightarrow W(x))$
Red is a color.	q_1	Cr	$\mathcal{C}R$	$\mathcal{C}(R)$
smokes and drinks	_	_	_	$\lambda x(S(x) \wedge D(x))$
every man	_	_	_	$\lambda X(\forall x(M(x) \rightarrow X(x)))$
every	_	_	_	$\lambda Y(\lambda X(\forall x(Y(x) \rightarrow X(x))))$
is	_	_	_	$\lambda X(\lambda x(X(x)))$
John probably smokes	$\Diamond$ p			
John necessarily smokes	$\Box$ p			

(M)PL: (Modal) Propositional Logic
FOL: First-Order Predicate Logic
SOL: Second-Order Predicate Logic
TL: Typed Logic (Higher-Order) with λ-calculus

Pragmatics

Natural Language	DRT
John smokes. He drinks as well.	[x: John(x), smoke(x)] $\oplus$ [v: drink(v)]

Natural Language	Inference	Canc.	Susp.	Reinf.	Neg.	Que.	Type
John killed the wasp.	The wasp died.	x	x	x	x	x	Entailment
John crashed his car. He is so smart.	He is not smart at all.	✓	(✓)	✓	x	x	Implicature
Before John started to smoke, he just drank.	John smokes.	x	x	x	✓	✓	Presupposition

DRT: Discourse Representation Theory

Thank You.

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