

Computational Semantics and Pragmatics

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Outline for this Week

Main topic: Referring expressions

- Today:
 - * Natural Language Generation (ultra brief overview)
focus on **generation of referring expressions** (GRE *aka* REG)
 - * Gricean pragmatics: conversational implicature
 - * Seminal paper by Dale & Reiter (1995)
- Tomorrow:
 - * The Incremental Algorithm by Dale & Reiter (1995)
 - * Some extensions of the Dale & Reiter approach
 - * Corpus-based approaches to GRE

Natural Language Generation

NLG is a subfield of Natural Language Processing. At an abstract level, one can think of it as the reverse of the process of Natural Language Understanding (NLU):

- **NLU**: Mapping human language into non-linguistic representations.
- **NLG**: Mapping non-linguistic representations of information into human language.

* “data” to text:

communicative goal, semantic input
(e.g., log files with numeric data,
reasoner’s output, logical forms)



natural language
(written or spoken)

- * in fact, there is also text-to-text NLG:
 - ▶ paraphrasing, summarization, textual simplification

NLG Applications: Examples

Some data-to-text NLG systems:

- FoG: textual weather forecasts from weather data developed by CoGenTex, in operation by Canadian weather service since 1992

<http://www.cogentex.com/solutions/portfolio.html>

- BabyTalk-Family: generates easy to understand reports on the medical condition of babies in neonatal care.

<http://www.saad.me.uk/research/btfamily/>

- iGraph: description of graphics for visually impaired people

<http://www.inf.udec.cl/~leo/igraph.html>

Choices in NLG

- What content should be included/omitted?
- How should that content be organised to be coherent?
- Which syntactic constructions should be used?
- How should entities be referred to?
- Which words should be chosen?

Ehud Reiter & Robert Dale (2000), *Building Natural Language Generation Systems*, Cambridge University Press

Abstract Architecture of an NLG System

- **Macroplanner (document planner)**: specification of content to be communicated and overall structure
 - * content determination
 - * document structuring
- **Microplanner**: syntactic structures and words to be used
 - * aggregation
 - * lexicalisation
 - * **generation of referring expressions**
- **Surface Realisation**: final output to be realised, e.g. with respect to punctuation, intonation, etc.
 - * linguistic realisation
 - * physical realisation

Choices in NLG

The Serbian Prime Minister, Zoran Djindjic, has been assassinated in the capital, Belgrade.

The pro-reform, pro-Western leader was shot in the stomach and in the back outside government offices at around 13:00 (12:00 GMT), and died of his wounds in hospital

The month was cooler than average. It was also drier than average, even though there was an average number of rainy days this month. Although there was rain every day for 8 days from the 11th, rainfall amounts were mostly small. Overall so far the year is much drier than average.

June was cooler and drier than average, with the average number of rainy days. The total rain for the year so far is well below average. Even though there was rain every day from the 11th to the 18th, rainfall amounts were mostly small.

Generation of Referring Expressions

GRE is concerned with the production of linguistic expressions that enable the hearer to identify one or more entities in a given context.

Referring expressions are important in all generation tasks.

Prototypically, REs are Noun Phrases.

- Definite NPs:

- * **Definite descriptions**: marked by definite determiners

The train is about to leave / Those trains will leave before ours.

- * **Proper names**

The Caledonian Express leaves for Aberdeen from track 11

- * **Pronouns**

It's about to leave / He'll miss it if he doesn't hurry

- Indefinite NPs: marked by indefinite determiners

A train is about to leave. / Some trains already arrived.

Initial and Subsequent Reference

- **Initial references** introduce an entity into the discourse context

- * Often indefinite NPs

A woman picked up an envelop.

- * But definite NPs are also possible: when an entity is already salient or is likely to be known or inferable by the hearer:

*Barack Obama gave a speech yesterday / Where is the train station? /
Switch off the TV*

- **Subsequent references** to an entity already introduced into the discourse. Typically use definite NPs.

*The Prime Minister was accused of bullying. He denied the charges.
The leader was shocked by the allegations.*

- * Subsequent reference is dependent on preceding material in the discourse \rightsquigarrow *anaphoric reference*. We must identify the *antecedent*.

GRE is a microcosmos of NLG

The two main modules assumed in GRE:

- **content determination**: deciding what information about the referent should be included
 - * *the month / last month / February / the shortest month of the year*
- **realisation** (syntactic realisation and lexical choice): deciding what structures and words to use to expressed that information
 - * *the current process / the process currently underway*
the average amount of edibles / the mean amount of food suplies

We are going to focus on a **very specific problem of GRE**:

- initial reference to entities that are already salient
 - by means of definite descriptions
 - whose only goal is to distinguish the referent for an addressee
 - focusing only on content determination
- ⇒ simple task enables in depth analysis of algorithms and impact of Gricean maxims.

Gricean Pragmatics

When we use language, we very often mean more than what we literally say:

- (1) A: Are you going to Paul's party?
B: I have to work.
 \rightsquigarrow *I am not going.*

- B *implies* that she's not going to the party *without saying it*.
- This enrichment of the literal meaning is not a logical implication or entailment of B's utterance – it depends on features of the **conversational** context → **conversational implicature**
- Grice proposes that conversational implicatures can be systematically accounted for by a set of general rationality principles for the efficient and effective use of language in conversation.

Paul H. Grice (1975) *Logic and Conversation*, in *Syntax and Semantics*, Vol. 3. New York: Academic Press

The CP and the Maxims

The Cooperative Principle: Make your contribution such as it is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged.

- Maxim of Quality: be truthful
 - * Do not say what you believe to be false.
 - * Do not say that for which you lack adequate evidence.
- Maxim of Quantity:
 - * Make your contribution as informative as is required (for the current purposes of the exchange).
 - * Do not make your contribution more informative than is required.
- Maxim of Relation: be relevant
- Maxim of Manner: be perspicuous.
 - * Avoid obscurity of expression / Avoid ambiguity.
 - * Be brief / Be orderly.

Grice's point is not that we adhere to these maxims on a superficial level, rather that we interpret utterances assuming that the principles are being followed at some deeper level, often contrary to appearances.

Types of Implicature

- The speaker is directly observing the maxims:

Both Kyle and Ellen need \$10 for their movie tickets.

Kyle to Ellen: "I have \$9"

Implicature: *Kyle does not have \$10.*

- The speaker violates a maxim that clashes with another one:

A: In which city does Kim live?

B: She lives somewhere in Spain.

Implicature: *B does not know which city Kim lives in.*

- The speaker is openly flouting a maxim to exploit it:

A newspaper review of a newly opened play: "Soap opera star Rose Singer produced a series of sounds corresponding closely to the score of an aria from Rigoletto."

Implicature: *the reviewer believes that Rachel Singer's performance was not good.*

Reference letter for a PhD position: "His hand writing is lovely"

Implicature: *the referee believes the applicant does not have better qualities*

Beyond Grice

Grice's proposals were brief and only suggestive of how work on the underlying ideas may proceed.

Work has indeed proceeded in several directions:

- Formal pragmatics: neo-gricean approaches, relevance theory, ...
- Experimental pragmatics: what do speakers/hearers actually do?
- Computational pragmatics: Dale & Reiter's paper is an example of how to interpret Grice's conversational maxims in a computational setting.

Dale & Reiter (1995) Computational interpretation of the Gricean maxims in the generation of referring expressions. *Cognitive Science*, 19(2):233–263.

Dale & Reiter 1995

D&R focus on referring expressions that:

- are realised as definite NPs - but they focus on content determination
- refer to physical objects
- their communicative goal is solely to identify a target object

the black dog

the woman with the glasses

the upside-down cup

D&R focus on three criteria an **algorithm for GRE** should satisfy:

1. it should produce expressions that satisfy the communicative goal: that allow the hearer to identify the intended object
2. it should produce expressions that do not lead the hearer to derive false implicatures
3. it should be computationally efficient

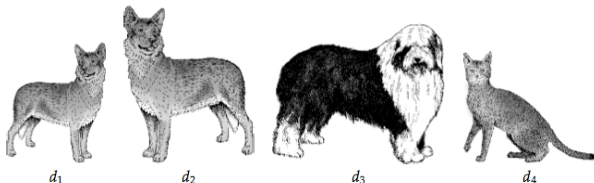
Satisfying the Communicative Goal

A referring definite description satisfies its communicative goal if it is a **distinguishing description**.

- Let D be the set of entities that are in the focus of attention of speaker and hearer (the **context set**).
- Each entity in D is characterised by means of a set of **properties** or attribute-value pairs such as $\langle \text{colour}, \text{red} \rangle$ or $\text{colour}=\text{red}$.
- If a property p does *not* apply to an entity $d \in D$, we say that p **rules out** d .
- Let $r \in D$ be the **target referent**, and C the **contrast set**: the set of all elements in D except r .

A set L of properties is a distinguishing description if the following conditions hold:

- C1.** Every property in L applies to r .
- C2.** For every $c \in C$, there is at least one property in L that rules out c .



$$D = \{d_1, d_2, d_3, d_4\}$$

$$r = d_1$$

$$C = \{d_2, d_3, d_4\}$$

Knowledge base representing the scene:

d_1 : type=dog, size=small, color=brown

d_2 : type=dog, size=large, color=brown

d_3 : type=dog, size=large, color=black+white

d_4 : type=cat, size=small, color=brown

Some examples of possible descriptions in this scenario:

content determination

$L = \{\text{type=dog, size=small}\}$

$L = \{\text{type=dog, colour=brown}\}$

$L = \{\text{type=dog, size=small, colour=brown}\}$

possible realisation

'the small dog'

'the brown dog'

'the small brown dog'

distinguishing

✓

×

✓

Are all distinguishing descriptions equally felicitous or appropriate?

For Tomorrow

- The TUNA corpus <http://homepages.abdn.ac.uk/k.vdeemter/pages/TunaCorpusManual/index.html>
 - * what is it?
 - * what does it mean “semantically transparent”?
 - * how has it been used?
- There is also the D-TUNA corpus
<http://tst-centrale.org/producten/corpora/d-tuna-corpus/6-57>