Game Theoretic Pragmatics
Session 6: Neo-Gricean Pragmatics

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Introduction

1. Status Quo: Basic knowledge of game theoretic tools
   ▶ to model language use (signaling games)
   ▶ to analyse emerging phenomena (Solution concepts: Nash Equilibrium, Iterated Strict Dominance, Rationalizability)

2. But now?
   ▶ How do I know, how a model for a particular Implicature should look like? (what kind of parameters?)
   ▶ Which solution concept is appropriate for Implicatures?

3. Outstanding Work:
   ▶ More formal concepts of Implicatures: *Neo-Gricean Pragmatics*
   ▶ Solution concept with an adequate epistemic interpretation, which at best gives the right results: *IBR-Model*
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Scalar Implicature

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Definition

A Scalar Implicature is a...

- Generalized Quantity Implicature based on the use of an informationally weak term in an *implication scale* like \( \langle all, some \rangle \)
- It’s use implicates that all similar utterances using an informationally stronger term are not true, because the speaker would use this more informative utterance (\( Q_1: "Make your contribution as informative as required." \))

Example:
A farmer says: "*Some* horses jumped over the fence." According scalar Implicature you would derive the information, that *not all* horses jumped over the fence.
Implication scale

An implicational scale is a set of lexical items that are

- of the same constituent category
- ordered in terms of their informativeness.

Examples

- \{ all, most, some \}
- \{ always, often, sometimes \}
- \{ succeed in, try to, want to \}
- \{ hot, warm \}
- \{ certain, probable, possible \}
- \{ n, ... 4, 3, 2, 1 \}
Definition

Formal Definition of Scalar Implicature:
Given an implication scale $\langle e_1, e_2...e_n \rangle$: If a speaker uses the utterance $U(e_i)$, he implicit means $\neg U(e_{i-1}) \land \neg U(e_{i-2}) \ldots \land \neg U(e_1)$.

Example: $\langle all, most, some \rangle$
$U(some) = Some$ horses jumped over the fence.
$\leftrightarrow \neg U(most) \land \neg U(all)$

Questions:
How does this account help us for choosing parameters for our signaling game model? How does it help us for finding an adequate solution concept?
Scalar Implicature

Division of pragmatic labour

Levinson’s 3 heuristics

Signaling game parameter $\langle \{S, R\}, T, Pr, M, [\cdot], A, U_S, U_R \rangle$

Model procedure:

- $M$ corresponds to a given implication scale $\langle e_1, e_2...e_n \rangle$
- $T$ contains states $t_{e_1}, t_{e_2\neg e_1}, \cdots t_{e_n\neg e_{n-1}...\neg e_1}$
- $A$ substantially matches with $T$
- $U_{S,R}(t, m, a) = \begin{cases} > 0 & \text{if } (t, a) \text{ is a match} \\ 0 & \text{else} \end{cases}$

<table>
<thead>
<tr>
<th>$Pr(t)$</th>
<th>$a_\forall$</th>
<th>$a_{\exists \neg \forall}$</th>
<th>$a_{\exists \neg \forall}$</th>
<th>$m_{all}$</th>
<th>$m_{most}$</th>
<th>$m_{some}$</th>
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</thead>
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<td>0,0</td>
<td>$\sqrt{}$</td>
<td>$\sqrt{}$</td>
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<td>$\sqrt{}$</td>
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<td>$1/2$</td>
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<td>0,0</td>
<td>1,1</td>
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Tabelle: Parameters of a signaling game for $\langle all, most, some \rangle$
Solution concept benchmark

Literal production/interpretation strategy:

- $t \forall \rightarrow m_{all} \rightarrow a \forall$
- $t \exists \leftrightarrow \forall \neg \rightarrow m_{some} \rightarrow a \exists \forall$
- $t \exists \land \neg \forall \rightarrow m_{most} \rightarrow a \exists \neg \forall$

Pragmatic production/interpretation strategy:

- $t \forall \rightarrow m_{all} \rightarrow a \forall$
- $t \exists \leftrightarrow \forall \neg \rightarrow m_{some} \rightarrow a \exists \forall$
- $t \exists \land \neg \forall \rightarrow m_{most} \rightarrow a \exists \neg \forall$
"In order to understand how and why a language changes, the linguist must keep in mind two ever-present and antinomic factors: First, the requirements of communication, the need for the speaker to convey his message, and second, the principle of least effort, which makes him restrict his output of energy, both mental and physical, to the minimum compatible with achieving his ends." (Marinet 1962)
Two basic and competing forces of linguistic realm

The force of unification (Speaker’s economy) is a direct least effort correlate, a drive toward simplification which would result in the evolution of exactly one totally unmarked infinitely ambiguous vocable.

The force of diversification (Auditor’s economy) is an antiambiguity principle leading toward the establishment of as many different expressions as there are messages to communicate.

"The two opposing economies are in extreme conflict.” (Zipf, 1949)
Horn’s two principles

**Q-Principle:** Make your contribution sufficient \((Q_1)\)
Say as much as you can (given R-Principle)

**R-Principle:** Make your contribution necessary \((Q_2, R, M)\)
Say no more than you must (given Q-Principle)
Q- vs. R-Principle

\( t_s \): Batman saved Gotham City.
1. \( \Rightarrow t_p \): It was possible for Batman to save Gotham City.
2. \( \Rightarrow t_a \): Batman was able to save Gotham City.

Q-Principle

\( m_p \): ’’It was possible for Batman to save Gotham City!’’
\( \Downarrow \neg t_s \): Batman didn’t save Gotham City.

R-Principle

\( m_a \): ’’Batman was able to save Gotham City!’’
\( \Downarrow t_s \): Batman saved Gotham City.
Tannen’s example

First exchange
Wife: Bob’s having a party. You wanna go?
Husband: Okay.

Second exchange (later)
Wife: Are you sure you want to go?
Husband: Okay. Let’s not go. I’m tired anyway.

Third exchange (post-mortem)
Wife: We didn’t go to the party because you didn’t want to.
Husband: I wanted to. You didn’t want to.
(Tannen, 1975)

Question: Who is right? OR What is the source of this misunderstanding?
Division of pragmatic labour

A unmarked message describes the prototypical case (R-Principle). A marked message excludes the prototypical case, thus describes a rare case (Q-Principle).

Example

"Black Bart killed the sheriff."
\[\rightarrow\] Murder in a prototypical way. (R)

"Black Bart caused the sheriff to die."
\[\rightarrow\] Murder in a non-prototypical way. (Q)
Signaling game parameter $\langle \{S, R\}, T, Pr, M, \mathbb{[}, \mathbb{]}, A, U_S, U_R, C \rangle$

Model procedure:

- $T = \{t_p, t_r\}$, $M = \{m_u, m_m\}$, $A = \{a_p, a_r\}$
- Prototypical case defined by $Pr$: $Pr(t_p) > Pr(t_r)$
- Introduce message cost function $C : M \rightarrow \mathbb{R}$
- Marked message defined by $C$: $C(m_m) > C(m_u)$
- $U_S(t, m, a) = T_S(t, a) - C(m)$;

<table>
<thead>
<tr>
<th></th>
<th>$Pr(t)$</th>
<th>$a_p$</th>
<th>$a_r$</th>
<th>$m_u$</th>
<th>$m_m$</th>
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<td>$t_r$</td>
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<td>✓</td>
<td>✓</td>
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Tabelle: Parameters of the game 'Division of pragmatic labour'
Solution concept benchmark

Some possible strategies:

Horn:

Anti-Horn:

Smolensky:

Nash Equilibria

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<tr>
<th></th>
<th>$R_H$</th>
<th>$R_{AH}$</th>
<th>$R_S$</th>
<th>$R_{AS}$</th>
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<td>.875, 1</td>
<td>-.125, 0</td>
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<td>$S_{AH}$</td>
<td>-.175, 0</td>
<td>.825, 1</td>
<td>.575, .75</td>
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<td>.65, .75</td>
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<tr>
<td>$S_{AS}$</td>
<td>.05, .25</td>
<td>.55, .75</td>
<td>.55, .75</td>
<td>.05, .25</td>
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Levinson’s Theory

“According to the standard line, there are just two levels to a theory of communication. A level of *sentence meaning* (grammar theory) and a level of *speaker meaning* (classical pragmatics).”

“What is omit is a third layer, what we may call the level of *utterance meaning*.”

“It is also at this level, naturally, that we can expect the *systematicity of inference that might be deeply interconnected to linguistic structure and meaning*...” (Levinson, 2000)
The 3 Heuristics

Utterance meaning is a result of *Default-Interpretations* applied according 3 heuristics:

- **Q-Heuristic**: What isn’t said to be the case, isn’t the case.
- **I-Heuristic**: What is said in a simple (unmarked) way represents a stereotypical situation.
- **M-Heuristic**: What is said in an abnormal (marked) way represents an abnormal situation.

Corresponding terminologies:

<table>
<thead>
<tr>
<th>Levinson</th>
<th>Q-Heuristic</th>
<th>M-Heuristic</th>
<th>I-Heuristic</th>
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<td>Grice</td>
<td>$Q_1$-Implicature</td>
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<td>Horn</td>
<td>$Q$-Principle</td>
<td>$Q$-Principle</td>
<td>$R$-Principle</td>
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</table>
I-Heuristic

What is said in a simple (unmarked) way represents a stereotypical situation.

- What is communicated is more precise than what is said.
- Inference to the best interpretation.
- Restriction of a more general predicate to a stereotypical instance.

Examples

"The secretary smiled." ⇔ The female secretary smiled.
"John had a drink." ⇔ John had an alcoholic drink.
"I like to drink milk." ⇔ I like to drink cows milk.
Signaling game parameter \( \langle \{S, R\}, T, Pr, M, [\cdot], A, U_S, U_R, C \rangle \)

**Model procedure:**

- \( T = \{t_c, t_g\}, M = \{m_m, m_c, m_g\}, A = \{a_c, a_g\} \)
- Prototypical case defined by \( Pr: Pr(t_c) > Pr(t_g) \)
- General predicate defined by \( C: C(m_m) < C(m_c) = C(m_g) \)

<table>
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<tr>
<th>Pr(t)</th>
<th>( a_c )</th>
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<th>( m_g )</th>
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**Tabelle:** Parameters of the game 'I-Heuristic'
Solution concept benchmark

- all these strategies are distinguishing
- all these strategies depict successful communication
- all these strategies are strict Nash Equilibria
- the first three strategies depict trustful sender behaviour
- only one strategy depicts pragmatic language use
Homework:

- 3rd homework sheet (due June 9)

Next Session:

- IBR-Model Part 1

References: