Implicatures and Preferential Games

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Communicated Meaning

Grice distinguishes between:

- What is said.
- What is implicated.

“Some of the boys came to the party.”

- **said:** at least two came
- **implicated:** not all came

Defeasibility of Implicatures

1. Some of the boys came to the party.
   $+>$ Not all of the boys came.

2. Some, perhaps all of the boys came to the party.
   $+>$ It is possible that all came, and it is possible that not all came.
   $+>$ $\Diamond$ all came $\&$ $\Diamond$ not all came.

3. I believe that some of the boys came to the party.
   $+>$ $\Diamond$ all came $\&$ $\Diamond$ not all came.

1. **State:** Exists variety of game theoretic model that explain conversational implicatures.
2. **Common:**
   1. Implicatures depend on common knowledge about speaker's expertise.
   2. Parameter is fixed in the models.
3. **Aim:** Sketch a framework for Game Theoretic Pragmatics which allows to model the mechanics of cancellation.

Outline

Section

Suspension of Implicatures

Suspension and Cancellation

“Some of the boys came to the party.”

1. **Cancellation:**
   Some, in fact all, of the boys came to the party.
2. **Suspension:**
   Some, perhaps all, of the boys came to the party.

Suspension and Clausal Implicatures

a) stronger form	b) weaker form	c) implicature of weaker form
know A	believe A	$\Diamond A \wedge \Diamond \neg A$
necessarily A	possibly A	$\Diamond A \wedge \Diamond \neg A$
A and B	A or B	$\Diamond A \wedge \Diamond \neg A \wedge \Diamond B \wedge \Diamond \neg B$

1. Some, possibly all of the boys came to the party.
   $+\!\!>$ $\Diamond$ all came & $\Diamond$ not all came.

2. I believe that some of the boys came to the party.
   $+\!\!>$ $\Diamond$ all came & $\Diamond$ not all came.

Gazdar's Incremental Account

Speaker has uttered A:

1. $e_0 := \{A\}$
2. e_1: Add all logical consequences to e_0.
3. e_2: Add all clausal implicatures which don't contradict e_1.
4. e_3: Add all scalar implicatures which don't contradict e_2.

Scalar implicatures are cancelled if they contradict logical consequences or clausal implicatures.

A Hirschberg Example

Extension to Relevance Implicatures

1. A: Does this job candidate speak Spanish?
   1. He speaks Portuguese.
      $+>$ He does not speak Spanish.
   2. B: I know he speaks Portuguese.
      $+>$ B does not know whether he speaks Spanish.

2. A: How did the students do in the exam?
   1. B: Some students passed.
      $+>$ Not many passed.
   2. B: I know that some students passed.
      $+>$ B does not know whether many passed.

Problem with Hirschberg Example

- **Know** does not create clausal implicatures.
- **(Quality)** $\Rightarrow$ Answers are logically equivalent.
- **Consequence:** Scalar implicatures should not be cancelled!

Back to the Roots

[Grice(1989), p. 86]

What is an implicature?

"... what is implicated is what is required that one assume a speaker to think in order to preserve the assumption that he is observing the Cooperative Principle (and perhaps some conversational maxims as well), ..."

Implicatures are consequences of the inferred knowledge of the speaker.

Representing Behaviour by Strategies

Conversational Strategies:

- Speaker chooses linguistic forms.
  Speaker's strategy S maps information states to forms (utterances).
- Hearer interprets utterance and possibly makes further decisions.
  Hearer's strategy H maps utterances to interpretations/actions.
- Strategies (S, H) that follow Gricean maxims can be described as equilibria of Signalling Games [Lewis(1969)].

Explanation of Implicatures

Optimal Answer Approach

- Start with a signalling game in which the hearer interprets forms by their literal meaning.
- Impose pragmatic constraints and calculate equilibria (S, H) that solve this game.
- Implicature $F +> \varphi$ is explained iff

$$S^{-1}(F) \models \varphi$$

$\Rightarrow$ In order to explain implicatures, we first have to be able to solve signalling games.

Necessary Components

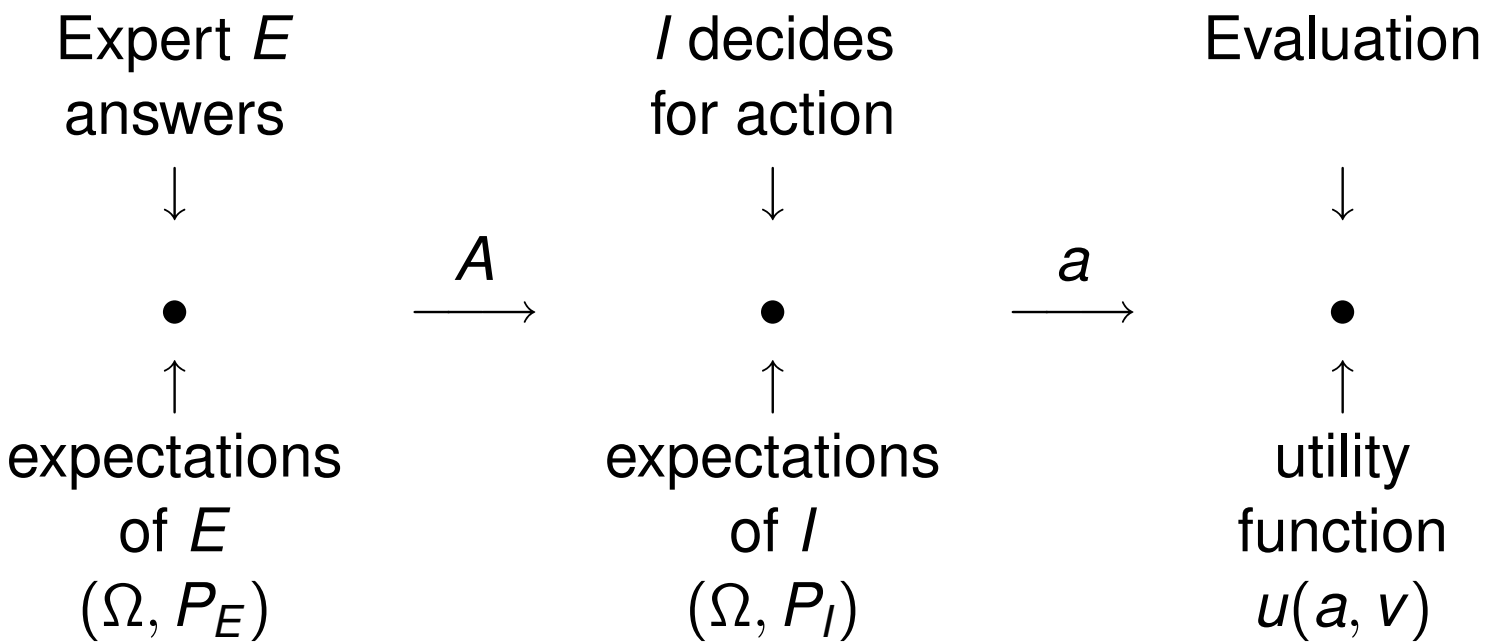
1. Game theoretic component: **Rational Interaction**,
2. Non-monotonic component: **Normality Assumptions**,
3. Cognitive Component: **Production Model**.

Section

The Game Theoretic Component

The Optimal Answer Model
[Benz(2006), Benz & v. Rooij(2007)]

General Situation



Support Problems

Definition 1 (Support Problem)

$\sigma = \langle \Omega, P_E, P_I, \mathcal{A}, u \rangle$ is a **support problem** if

- (Ω, P_E) is a finite probability space, and
- $\langle (\Omega, P_I), \mathcal{A}, u \rangle$ a decision problem.

We assume:

$$\forall X \subseteq \Omega \; P_E(X) = P_I(X|K) \text{ for } K = \{v \in \Omega \mid P_E(v) > 0\}. \tag{1}$$

The Maxims

with representation of Gricean maxims

(Quality) This restricts the expert's answers to the propositions he believes to be true:

$$Adm_\sigma := \{A \subseteq \Omega \mid P_E(A) = 1\}$$

(Utility) Calculate optimal answers by **Backward Induction**.

$\Rightarrow$ Replaces (Relevance) and (Quantity)

Definition of Implicatures

Definition 2 (Implicature)

Let $\sigma = \langle \Omega, P_E, P_I, \mathcal{A}, u \rangle$ be a set of support problem with a shared decision problem. For propositions A, H we define:

$$A +\!> H :\Leftrightarrow \ \forall \sigma \in \mathcal{S} : \ A \in \mathrm{Op}_\sigma \rightarrow P_E^\sigma(H) = 1,$$

with Op_σ the set of admissible optimal answers of support problem σ.

Section

The Non–Monotonic Component

Normality

A Classical Explanation

Scalar Implicatures

"Some of the boys came to the party."

1. $\Box A(\forall) \rightarrow \mathrm{Utter}_S\ A(\forall)$ (**Quantity**)
2. $\mathrm{Utter}_S\ A(\exists)$ (fact)
3. $\neg\Box A(\forall)$ (follows from lines 1 & 2)
4. $\Box A(\exists)$ (follows from l. 2 and **Quality**)
5. $\Box A(\neg\exists) \vee \Box A(\exists \wedge \neg\forall) \vee \Box A(\forall)$ (**Expert**)
6. $\Box A(\exists \wedge \neg\forall)$ (follows from lines 3., 4., and 5.)

Expert: Assumption that the speaker is an expert, i.e. knows the true state of the world.

Compare also [de Jager(2007)].

A Classical Explanation

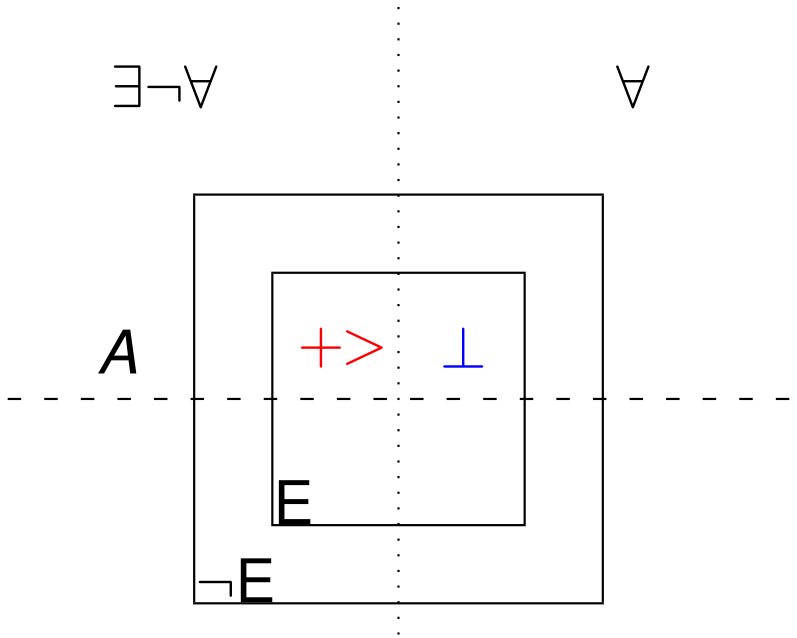
Suspension of Scalar Implicatures

"Some, perhaps all, of the boys came to the party."

1. $\Box A(\exists) \wedge \Diamond A(\forall)$ (logical form of utterance and **Quality**)
2. $\Box A(\neg\exists) \vee \Box A(\exists \wedge \neg\forall) \vee \Box A(\forall)$ (**Expert**)
3. $\Box A(\forall)$ (follows from previous lines)
4. $\Box A(\forall) \rightarrow \mathrm{Utter_S}\ A(\forall)$ (**Quantity**)
5. *Contradiction* (because speaker did not utter $A(\forall)$)
6. $\neg$(**Expert**) $\equiv \Diamond\neg A(\neg\exists) \wedge \Diamond\neg A(\exists \wedge \neg\forall) \wedge \Diamond\neg A(\forall)$
7. $\Box A(\exists) \wedge \Diamond A(\neg\forall) \wedge \Diamond A(\forall)$ (from the first and the previous line)

A Graphical Interpretation

Scalar Implicature

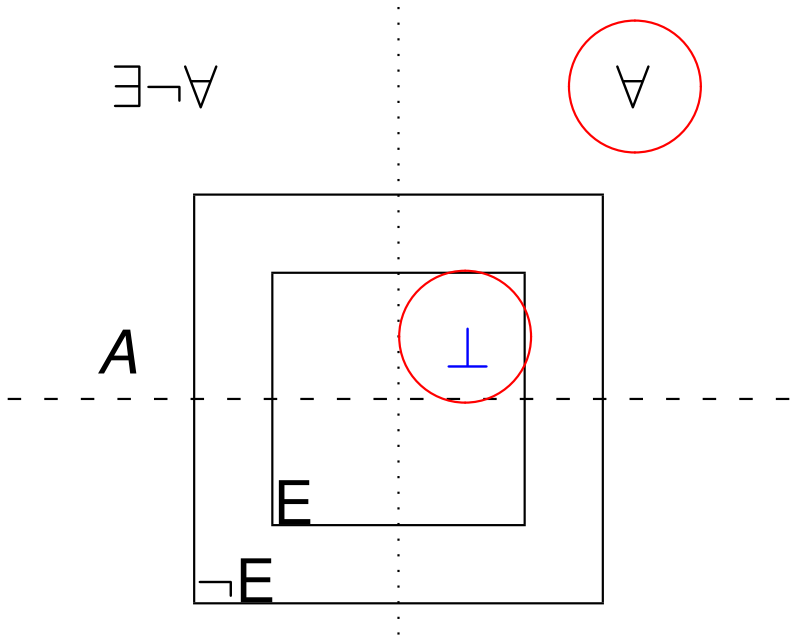


$A \equiv A(\exists), \quad \bot \equiv$ contradicts maxims

$B \equiv A(\exists) \wedge \Diamond A(\forall)$

A Graphical Interpretation

Cancellation

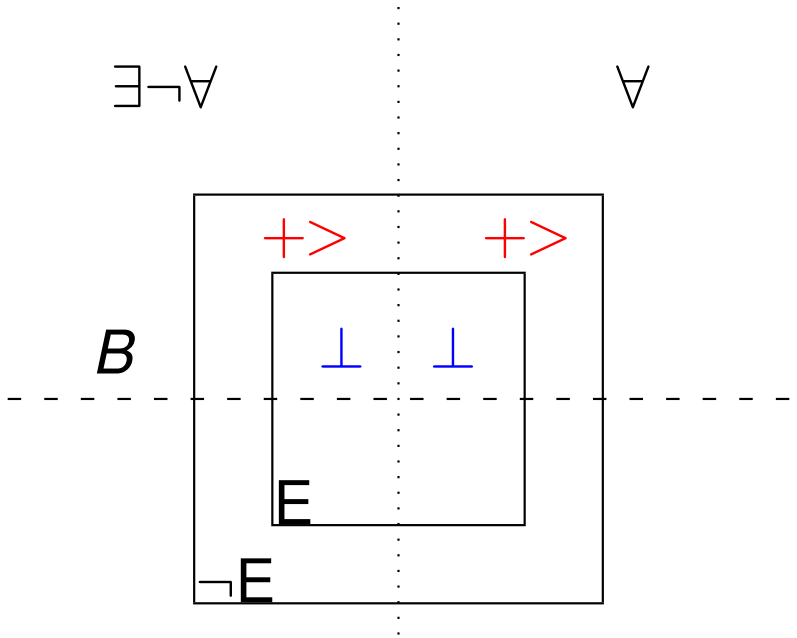


$A \equiv A(\exists)$, $\quad \bot \equiv$ contradicts maxims

$B \equiv A(\exists) \wedge \Diamond A(\forall)$

A Graphical Interpretation

Suspension



$A \equiv A(\exists), \quad \bot \equiv$ contradicts maxims
$B \equiv A(\exists) \wedge \Diamond A(\forall)$

Normality

Definition 3 (Preferential Models)

Let $\mathcal{S}$ be the set of all support problems, then $\langle \mathcal{S}, \mathcal{C}, \sqsubseteq \rangle$ is a *preferential* model of support problems if

1. $\mathcal{C}$ a partition of $\mathcal{S}$,
2. $\sqsubseteq$ a well-founded linear order of $\mathcal{C}$.

We set

$$\mathrm{Min}(F) := \min\{C \in \mathcal{C} \mid \exists \sigma \in C\ F \in \mathrm{Op}_\sigma\}$$

Normality

Definition 4 (The Principle of Normality)

Let $\langle \mathcal{S}, \mathcal{C}, \sqsubseteq \rangle$ be a preferential model of support problems, $F \in \mathcal{F}$, and $\sigma \in \mathrm{Min}(F)$, then an utterance of F implicates that H iff

$$\forall \hat{\sigma} \in [\sigma]_{\mathcal{S}} \cap \mathrm{Min}(F) : \; A \in \mathrm{Op}_{\hat{\sigma}} \rightarrow P_E^{\hat{\sigma}}(H) = 1, \tag{2}$$

with $[\sigma]_{\mathcal{S}}$ the set of all support problems that only differ in P_E from σ.

Section

The Cognitive Component

The Production Model

A: Does this job candidate speak Spanish?

He speaks Portuguese.

$+>$ He does not speak Spanish.

$$
\begin{array}{ccccc}
?A(h,S) & & & & \\
\downarrow & & & & \\
\neg A(h,S) & \overset{\notin \mathrm{Op}_\sigma}{\rightsquigarrow} & ?y.A(h,y) & & \\
 & & \downarrow & & \\
 & & A(h,P) & \overset{\in \mathrm{Op}_\sigma}{\rightsquigarrow} & \textit{Produce}
\end{array}
$$

A: Does this job candidate speak Spanish?

I know he speaks Portuguese.

$+>$ Speaker does not know whether he speaks Spanish.

$$?A(h,S) \downarrow \neg\Box?A(h,S) \overset{\notin \mathrm{Op}_\sigma}{\rightsquigarrow} ?y.\Box A(h,y) \downarrow \Box A(h,P) \overset{\in \mathrm{Op}_\sigma}{\rightsquigarrow} \textit{Produce}$$

$$\Box?A \equiv \neg\Box A \wedge \neg\Box\neg A$$

Competition between Forms

- Speaker knows that candidate doesn't speak Spanish but speaks Portuguese
  1. *He speaks Portuguese* $\in \mathrm{Op}_\sigma$ (Principle of Normality).
  2. *I know that he speaks Portuguese* $\notin \mathrm{Op}_\sigma$ "(Manner)"

- Speaker doesn't know whether candidate speaks Spanish but knows he speaks Portuguese:
  1. *He speaks Portuguese* is misleading (Normality), hence $\notin \mathrm{Op}_\sigma$.
  2. *I know that he speaks Portuguese* $\in \mathrm{Op}_\sigma$ (Best Candidate)

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