

Cooperative interpersonal communication and relevant information

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Outline

- 1 Cooperativity**
 - Example
 - Definition
- 2 Relevance**
 - Formal definition
 - Properties
 - Hierarchy
- 3 Back to cooperativity**
- 4 Conclusion and perspectives**

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Example



Agent a

late?

incident → late



Agent c

incident

rain



Agent b

late?

¬incident → ¬late

Example



Agent a

late?

incident → *late*



Agent c

incident

rain



Agent b

late?

¬incident → *¬late*

Example



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Example



Agent a

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late?

¬incident → *¬late*

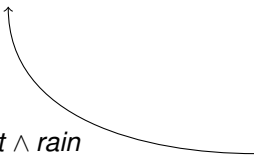


Agent c

incident

rain

incident ∧ *rain*



Example



Agent a

late?

incident → *late*



Agent b

late?

\neg *incident* → \neg *late*



Agent c

incident

rain

incident \wedge *rain*

Example



Agent a

late?

incident → *late*



Agent c

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Agent b

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¬incident → *¬late*

Example



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Relevance

Let a be an agent, Q an objective formula, φ a formula. We say that φ is relevant for agent a concerning Q iff the following formula, denoted $R_a^Q \varphi$, is true :

$$I_a(B_a Q \vee B_a \neg Q) \wedge \varphi \wedge (B_a(\varphi \rightarrow Q) \otimes B_a(\varphi \rightarrow \neg Q))$$

- Information need :
agent a wants to know whether Q or $\neg Q$
- Piece of information truth value :
the piece of information φ must be true
- Agent's beliefs base :
agent a believes that $\varphi \rightarrow Q$ or that $\varphi \rightarrow \neg Q$

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A few properties

Proposition 1

$$R_a^Q \varphi \rightarrow \neg B_a \varphi \wedge B_a \neg \varphi$$

If φ is a relevant piece of information for agent a , then she does not know neither φ nor $\neg\varphi$.

Proposition 2

- $I_a(B_a Q \vee B_a \neg Q) \rightarrow R_a^Q Q \text{ xor } R_a^Q \neg Q$
- $(Q_1 \leftrightarrow Q_2) \rightarrow (R_a^{Q_1} \varphi \leftrightarrow R_a^{Q_2} \varphi)$
- $R_a^Q \varphi \rightarrow \neg R_a^Q \neg \varphi$
- $\neg(\varphi_1 \wedge \varphi_2) \rightarrow \neg(R_a^{Q_1} \varphi_1 \wedge R_a^{Q_2} \varphi_2)$

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Proposition 5

$$B_a(\varphi_1, \varphi_2/Q) \rightarrow (\varphi_2 \wedge R_a^Q \varphi_1 \rightarrow R_a^Q(\varphi_1 \wedge \varphi_2))$$

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Minimal explanation

Definition : Explanation

Let Δ be a set of objective formulae and α and β two objective formulae.

β is an explanation of α if and only if $\vdash B\Delta \rightarrow B(\beta \rightarrow \alpha)$ and $\not\vdash B\Delta \rightarrow B(\neg\beta)$.

Intuition : Minimal explanation

- for cubes : α is a minimal explanation of β iff there is no other explanation α' of β such that $\alpha \rightarrow \alpha'$ and $\alpha \not\leftrightarrow \alpha'$ (prime implicants)
- for clauses : α is a minimal explanation of β iff there is no other explanation α' of β such that $\alpha' \rightarrow \alpha$ and $\alpha' \not\leftrightarrow \alpha$ (maxima for subsumption)

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Most relevant formulae

Let \mathcal{R}_a^Q be the set of relevant formulae. For all φ in \mathcal{R}_a^Q , we have $B_a(\varphi \rightarrow Q)$ or $B_a(\varphi \rightarrow \neg Q)$ and $\neg B_a(\neg\varphi)$, that means that for all φ in \mathcal{R}_a^Q , φ is an explanation of Q or $\neg Q$.

Definition

Let $\mathcal{R}m_a^Q$ be the subset of \mathcal{R}_a^Q that contains the minimal explanations of Q and $\neg Q$. We will write $Rm_a^Q\varphi$ to express that the formula φ belongs to $\mathcal{R}m_a^Q$.

Example

Let us consider the following set of relevant pieces of information to agent a concerning her request Q :

$\mathcal{R}_a^Q = \{inc \wedge rain, inc \vee strike, strike\}$. Then $\mathcal{R}m_a^Q = \{strike, inc \wedge rain\}$.

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A more formal definition

Let a and c be two agents. The agent c is cooperative with regard to a iff for all formula φ , c informs a about φ if and only if there is a request Q such that c believes that φ is maximal relevant for a concerning Q . This is represented by :

$$\text{Coop}(c, a) \equiv \forall \varphi \text{Inf}_{c,a} \varphi \leftrightarrow \exists Q, B_c(Rm_a^Q \varphi)$$

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Conclusion and perspectives

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- Characterization of most relevant pieces of information for an agent
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Axiomatics

- Propositional tautologies and propositional inference rules ;

- KD45 for B_a ,

$$(K) \vdash B_a(\varphi \rightarrow \psi) \wedge B_a\varphi \rightarrow B_a\psi$$

$$(D) \vdash B_a\varphi \rightarrow \neg B_a\neg\varphi$$

$$(4) \vdash B_a\varphi \rightarrow B_a B_a\varphi$$

$$(5) \vdash \neg B_a\varphi \rightarrow B_a\neg B_a\varphi$$

- (Nec) Necessitation for B_a , $\frac{\vdash \varphi}{\vdash B_a\varphi}$

- (UE) Unit exclusion for I_a , $\vdash \neg I_a(\top)$

- BI Introspection,

$$(BI1) \vdash I_a\varphi \rightarrow B_a I_a\varphi$$

$$(BI2) \vdash \neg I_a\varphi \rightarrow B_a\neg I_a\varphi$$

$$(BI3) \vdash B_a(\varphi \leftrightarrow \psi) \rightarrow (I_a\varphi \leftrightarrow I_a\psi)$$

▶ Back