THE MANY FACES OF DECEPTION

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Deception

- Deception is an act whereby one person causes another person to have a false belief.
- In spite of its commonality in human society, little study has been devoted to developing a formal account of deception.
- By understanding what deception is, one can consider the best ways of using deception to achieve a particular goal, and the best ways in which one could avoid being deceived.

Definition of Deception

- Studied by a number of philosophers and many different definitions exist.
- Chisholm and Feehan (1977) provide eight basic ways of deception.
- These categories are further divided depending on whether the deception is intended or not.

Contributions

- Formulate 8 different categories of deception using a modal logic of belief and action.
- Investigate formal properties of deception and propose postulates that should ideally be satisfied by agents.
- Argue the difference between intended deception, lying and withholding information.

Logic for Belief and Action [Pörn 1977,1989]

- A multi-modal logic with 3 modalities

  $B_a\phi$: *a* believes ϕ

  $D_a\phi$: it is necessary for something which *a* does ϕ

  $D'_a\phi$: but for *a*'s action it would be the case that ϕ

- A unary predicate representing a speech act

  $utter_{ab}(\phi)$: *a* expresses a sentence ϕ to *b*

The Axiom System for BDD′

- The axiom system for the B-operator is KD45, while those for the D-operator and the D′-operator are KT and KD, respectively.
- A logic BDD′ has the following axioms and inference rules.

(P) All propositional tautologies

(U_c) $\mathrm{utter}_{ab}(\phi \wedge \psi) \equiv \mathrm{utter}_{ab}(\phi) \wedge \mathrm{utter}_{ab}(\psi)$

(K_B) $B_a\phi \wedge B_a(\phi \supset \psi) \supset B_a\psi$ (K_D) $D_a\phi \wedge D_a(\phi \supset \psi) \supset D_a\psi$

($K_{D'}$) $D'_a\phi \wedge D'_a(\phi \supset \psi) \supset D'_a\psi$ (T_D) $D_a\phi \supset \phi$

(D_B) $B_a\phi \supset \neg B_a\neg\phi$ ($D_{D'}$) $D'_a\phi \supset \neg D'_a\neg\phi$

(4_B) $B_a\phi \supset B_aB_a\phi$ (5_B) $\neg B_a\phi \supset B_a\neg B_a\phi$

(MP) $\phi,\ \phi \supset \psi \,/\, \psi$ (N_B) $\phi \,/\, B_a\phi$

(N_D) $\phi \,/\, D_a\phi$ ($N_{D'}$) $\phi \,/\, D'_a\phi$

Two Action Operators

- $E_a\phi = D_a\phi \wedge \neg D'_a\phi$
  : it is necessary for something which *a* does ϕ, but for *a*'s action it would not be the case that ϕ.
  "*a* brings it about that ϕ"

- $F_a\phi = \neg D_a \neg \phi \wedge \neg D'_a\phi$
  : it is compatible with everything which *a* does that ϕ, but for *a*'s action it would not be the case that ϕ.
  "*a* let it be the case that ϕ"

Properties of E and F

- (T_E) $E_a\phi \supset \phi$
- (D_E) $E_a\phi \supset \neg E_a \neg \phi$
- (K_E) $E_a(\phi \supset \psi) \supset (E_a\phi \supset E_a\psi)$
- (C_E) $(E_a\phi \wedge E_a\psi) \supset E_a(\phi \wedge \psi)$
- (No) $\neg E_a T \wedge \neg F_a T$
- (EF) $E_a\phi \supset F_a\phi$

✓ (T_E) represents the success of actions, while (No) represents that no agent can bring about what is logically true.

Causal Relation
[Sandu 1986]

- $\phi \Rightarrow \psi$: "ψ is a consequence of ϕ"
- It satisfies the following axioms and inference rules:
  (C1) $\neg(\phi \Rightarrow \bot)$
  (C2) $(\phi \Rightarrow \psi \wedge \psi \Rightarrow \chi) \supset \phi \Rightarrow \chi$
  (C3) $(\phi \Rightarrow \psi) \supset \neg(\psi \Rightarrow \phi)$
  (C4) $\neg(\phi \Rightarrow \psi \wedge \neg\phi \Rightarrow \psi)$
  (C5) $(\phi \Rightarrow \psi) \supset (\phi \wedge \psi)$
  (C6) $(\phi \Rightarrow \psi \wedge \phi \Rightarrow \chi) \supset (\phi \Rightarrow \psi \wedge \chi)$
  (C7) $\phi \equiv \psi \ / \ (\phi \Rightarrow \chi) \equiv (\psi \Rightarrow \chi)$
  (C8) $\phi \equiv \psi \ / \ (\chi \Rightarrow \phi) \equiv (\chi \Rightarrow \psi)$
- A logic BDD'C is an extension of BDD' with (C1)-(C8).

Deception by Commission
[Chisholm and Feehan, 1977]

- *a*, *b*: two agents; *p*: a false proposition

(DC1) *a* contributes causally toward *b*'s acquiring the belief in *p* (positive deception simpliciter).

(DC2) *a* contributes causally toward *b*'s continuing in the belief in *p* (positive deception secundum quid).

(DC3) *a* contributes causally toward *b*'s ceasing to believe in $\neg p$ (negative deception simpliciter).

(DC4) *a* contributes causally toward preventing *b* from acquiring the belief in $\neg p$ (negative deception secundum quid).

Positive Deception by Commission: Definition

- $PDSC_{ab}(\sigma) = B_a \neg\sigma \wedge (utter_{ab}(\sigma) \Rightarrow E_a B_b \sigma)$
  : *a* deceives *b* on σ by PDSC if *a* utters a believed-false sentence σ and the utterance causally brings it about that *b* believes σ.
- $PDSQC_{ab}(\sigma) = B_a \neg\sigma \wedge (utter_{ab}(\sigma) \Rightarrow F_a B_b \sigma)$
  : *a* deceives *b* on σ by PDSQC if *a* utters a believed-false sentence σ and the utterance causally lets it be the case that *b* believes σ.

Example

- Suppose a salesperson *a* who believes that a product has no value ($B_a \neg$valuable).
- If the salesperson utters to a customer *b* that it is valuable ($utter_{ab}$(valuable))
- and the speech act leads the customer, who disbelieves that the product is valuable, to believing it valuable ($E_a B_b$valuable), then it is $PDSC_{ab}$(valuable).
- On the other hand, if the speech act could let the customer, who believes that the product is valuable, continue to have the (wrong) belief ($F_a B_b$valuable), then it is $PDSQC_{ab}$(valuable).

Negative Deception by Commission: Definition

- $NDSC_{ab}(\sigma) = B_a \neg\sigma \wedge (utter_{ab}(\sigma) \Rightarrow E_a \neg B_b \neg\sigma)$
  : *a* deceives *b* on σ by NDSC if *a* utters a believed-false sentence σ and the utterance causally brings it about that *b* disbelieves $\neg\sigma$.
- $NDSQC_{ab}(\sigma) = B_a \neg\sigma \wedge (utter_{ab}(\sigma) \Rightarrow F_a \neg B_b \neg\sigma)$
  : *a* deceives *b* on σ by NDSQC if *a* utters a believed-false sentence σ and the utterance causally lets it be the case that *b* disbelieves $\neg\sigma$ (thus preventing *b* from acquiring $\neg\sigma$).

Example

- Consider again a salesperson *a* who believes that a product has no value ($B_a \neg valuable$).
- If the salesperson utters to a customer *b* that it is valuable ($utter_{ab}(valuable)$)
- and the speech act makes the customer believe the possibility of the value ($E_a \neg B_b \neg valuable$), then it is $NDSC_{ab}(valuable)$.
- On the other hand, if by the speech act the customer continues to believe the possibility of the value ($F_a \neg B_b \neg valuable$), then it is $NDSQC_{ab}(valuable)$.

Deception by Omission
[Chisholm and Feehan, 1977]

- *a*, *b*: two agents; *p*: a false proposition

(DO1) *a* allows *b* to acquire the belief in *p* (positive deception simpliciter).

(DO2) *a* allows *b* to continue in the belief in *p* (positive deception secundum quid).

(DO3) *a* allows *b* to cease to have the belief in $\neg p$ (negative deception simpliciter).

(DO4) *a* allows *b* to continue without the belief in $\neg p$ (negative deception secundum quid).

Remark

- Here, an agent allows a certain state of affairs to occur provided only (i) he/she could prevent that state of affairs from occurring, and (ii) he/she does not thus prevent it from occurring.
- We capture the act that "*a* allows *b*" as "*a* makes no utterance to *b* on a believed-true sentence".
- That is, *a* proactively do nothing to affect *b*'s state of mind of believing what is true.

Positive Deception by Omission: Definition

- $PDSO_{ab}(\sigma) = B_a \neg\sigma \wedge (\neg utter_{ab}(\neg\sigma) \Rightarrow E_a B_b \sigma)$
  : *a* deceives *b* on σ by PDSO if *a* does not utter a believed-true sentence ¬σ and the non-utterance causally brings it about that *b* believes σ.
- $PDSQO_{ab}(\sigma) = B_a \neg\sigma \wedge (\neg utter_{ab}(\neg\sigma) \Rightarrow F_a B_b \sigma)$
  : *a* deceives *b* on σ by PDSQO if *a* does not utter a believed-true sentence ¬σ and the non-utterance causally lets it be the case that *b* believes σ.

Example

- Suppose a child *a* who believes that he/she failed to get a passing grade ($B_a \neg pass$), but does not utter the fact to his/her parent *b* ($\neg utter_{ab}(\neg pass)$).
- If the non-utterance leads the parent to believing that the child gets a passing grade ($E_a B_b pass$), then it is $PDSO_{ab}(pass)$.
- On the other hand, if the non-utterance leads the parent to retaining the wrong belief ($F_a B_b pass$), then it is $PDSQO_{ab}(pass)$.

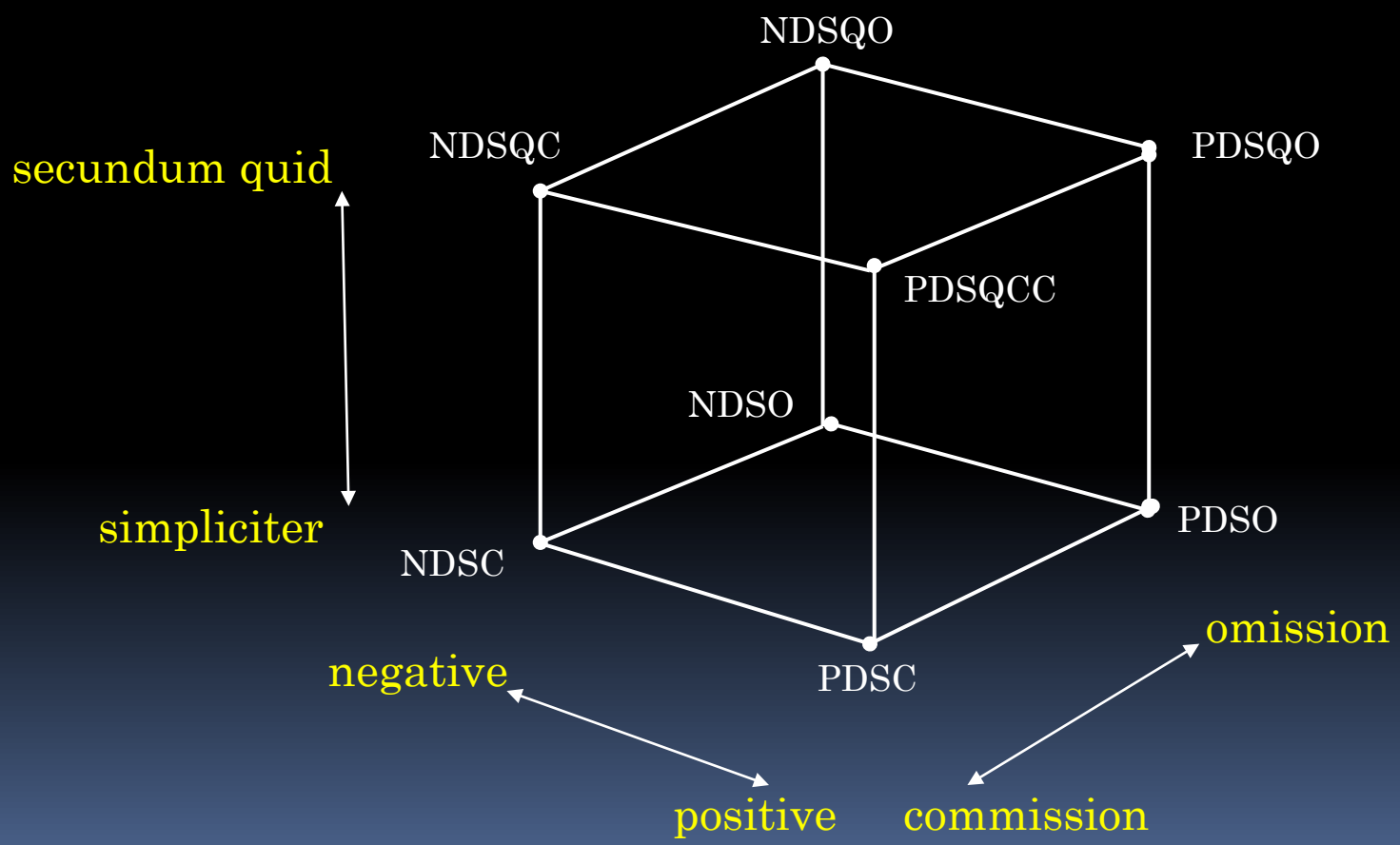
Negative Deception by Omission: Definition

- $NDSO_{ab}(\sigma) = B_a \ulcorner\sigma \wedge (\ulcorner utter_{ab}(\ulcorner\sigma) \Rightarrow E_a \ulcorner B_b \ulcorner\sigma)$
  : *a* deceives *b* on σ by NDSO if *a* does not utter a believed-true sentence $\ulcorner\sigma$ and the non-utterance causally brings it about that *b* disbelieves $\ulcorner\sigma$.
- $NDSQO_{ab}(\sigma) = B_a \ulcorner\sigma \wedge (\ulcorner utter_{ab}(\ulcorner\sigma) \Rightarrow F_a \ulcorner B_b \ulcorner\sigma)$
  : *a* deceives *b* on σ by NDSQO if *a* does not utter a believed-true sentence $\ulcorner\sigma$ and the non-utterance causally lets it be the case that *b* disbelieves $\ulcorner\sigma$.

Example

- Consider again a child *a* who believes that he/she failed to get a passing grade ($B_a \neg pass$), but does not utter the fact to his/her parent *b* ($\neg utter_{ab}(\neg pass)$).
- If the non-utterance makes the parent believe the possibility of the child's getting a passing grade ($E_a \neg B_b \neg pass$), then it is $NDSO_{ab}(pass)$.
- On the other hand, if the non-utterance leads the parent to retaining the belief on the possibility of the child's getting a passing grade, ($F_a \neg B_b \neg pass$), then it is $NDSQO_{ab}(pass)$.

8 Categories of Deception



Deception by Commission (DC) v.s. Deception by Omission (DO)

- DC is considered to be more sinful than DO because in DC a deceiver behaves more proactively than in DO.
- Thus, PDSC is worse (or more sinful) than PDSO, PDSQC is worse than PDSQO, NDSC is worse than NDSO, and NDSQC is worse than NDSQO.
- These relations imply a guideline for a speech-act of deception that should ideally be satisfied by the agents, for moral as well as for self-interested reasons (lower punishments if caught).

Postulates for DC and DO

(PDSC-PDSO)

$B_a(PDSC_{ab}(\sigma)) \wedge B_a(PDSO_{ab}(\sigma)) \supset \neg PDSC_{ab}(\sigma)$

"if *a* believes that both PDSC and PDSO are effective, then *a* does no opt for PDSC."

(PDSQC-PDSQO)

$B_a(PDSQC_{ab}(\sigma)) \wedge B_a(PDSQO_{ab}(\sigma)) \supset \neg PDSQC_{ab}(\sigma)$

(NDSC-NDSO)

$B_a(NDSC_{ab}(\sigma)) \wedge B_a(NDSO_{ab}(\sigma)) \supset \neg NDSC_{ab}(\sigma)$

(NDSQC-NDSQO)

$B_a(NDSQC_{ab}(\sigma)) \wedge B_a(NDSQO_{ab}(\sigma)) \supset \neg NDSQC_{ab}(\sigma)$

Formal Properties

- Let Dec be one of the 8 categories of deception. Then the followings are proved.
- It is inconsistent to deceive on valid(T) or contradictory(⊥) sentences.

  $Dec_{ab}(T) \supset \bot$ and $Dec_{ab}(\bot) \supset \bot$
- Self-deception leads to contradiction.

  $Dec_{aa}(\sigma) \supset \bot$
- Deceptions do not work conjunctively.

  $Dec_{ab}(\sigma) \wedge Dec_{ab}(\lambda) \not\supset Dec_{ab}(\sigma \wedge \lambda)$

Intended Deception

- Deception is often accompanied by intention.
- The logic BDD'C is extended to BDD'CI by introducing the modality $I_a\phi$ representing that "an agent *a* intends ϕ".
- The I-operator follows the KD45 system.

(P) All propositional tautologies

(K_I) $I_a\phi \wedge I_a(\phi \supset \psi) \supset I_a\psi$

(D_I) $I_a\phi \supset \neg I_a\neg \phi$

(4_{IB}) $I_a\phi \supset B_aI_a\phi$

(5_{IB}) $\neg I_a\phi \supset B_a\neg I_a\phi$

(MP) ϕ, $\phi \supset \psi$ / ψ

(N_I) ϕ / $I_a\phi$

Intended Deception by Commission: Definition

- $IPDSC_{ab}(\sigma,\phi) = B_a \neg\phi \wedge I_a B_b \phi \wedge B_a B_b(\sigma \supset \phi) \wedge (utter_{ab}(\sigma) \Rightarrow E_a B_b \phi)$

  : *a* deceives *b* on σ for ϕ by IPDSC if

  - *a* has an intention to make *b* believe the believed-false sentence ϕ,

  - *a* believes that a sentence σ leads *b* to believing ϕ, and

  - the utterance of σ brings it about that *b* believes ϕ.

- $IPDSQC_{ab}(\sigma,\phi) = B_a \neg\phi \wedge I_a B_b \phi \wedge B_a B_b(\sigma \supset \phi) \wedge (utter_{ab}(\sigma) \Rightarrow F_a B_b \phi)$

- $INDSC_{ab}(\sigma,\phi) = B_a \neg\phi \wedge I_a \neg B_b \neg\phi \wedge B_a B_b(\sigma \supset \phi) \wedge (utter_{ab}(\sigma) \Rightarrow E_a \neg B_b \neg\phi)$

- $INDSQC_{ab}(\sigma,\phi) = B_a \neg\phi \wedge I_a \neg B_b \neg\phi \wedge B_a B_b(\sigma \supset \phi) \wedge (utter_{ab}(\sigma) \Rightarrow F_a \neg B_b \neg\phi)$

Example

- Bob and Mary are working at the same office and Bob is playing a computer game. They know that their boss usually arrives at the office at ten o'clock ($B_a B_b(\text{ten} \supset \text{boss})$).
- Mary knows that the boss will not arrive at ten today for some reasons ($B_a \neg \text{boss}$), but intends Bob to believe he'll arrive ($I_a B_b \text{boss}$), in order for Bob to stop playing the game.
- When the clock strikes ten, she utters "Now it's ten o'clock" ($\text{utter}_{ab}(\text{ten})$).
- From this utterance, it follows that Bob realizes the boss is coming ($E_a B_b \, \text{boss}$).
- This is an example of $\text{IPDSC}_{ab}(\text{ten}, \text{boss})$.

DC v.s. Intended DC (IDC)

When $\phi \equiv \sigma$, IDC is simplified as

- $IPDSC_{ab}(\sigma, \sigma) = PDSC_{ab}(\sigma) \wedge I_a B_b \sigma$
- $IPDSQC_{ab}(\sigma, \sigma) = PDSQC_{ab}(\sigma) \wedge I_a B_b \sigma$
- $INDSC_{ab}(\sigma, \sigma) = NDSC_{ab}(\sigma) \wedge I_a \neg B_b \neg \sigma$
- $INDSQC_{ab}(\sigma, \sigma) = NDSQC_{ab}(\sigma) \wedge I_a \neg B_b \neg \sigma$

Intended Deception by Omission: Definition

- $IPDSO_{ab}(\sigma,\phi) = B_a \neg\phi \wedge I_a B_b \phi$
  $\wedge B_a B_b(\neg\sigma \supset \neg\phi) \wedge (\neg utter_{ab}(\neg\sigma) \Rightarrow E_a B_b \phi)$
- $IPDSQO_{ab}(\sigma,\phi) = B_a \neg\phi \wedge I_a B_b \phi$
  $\wedge B_a B_b(\neg\sigma \supset \neg\phi) \wedge (\neg utter_{ab}(\neg\sigma) \Rightarrow F_a B_b \phi)$
- $INDSO_{ab}(\sigma,\phi) = B_a \neg\phi \wedge I_a \neg B_b \neg\phi$
  $\wedge B_a B_b(\neg\sigma \supset \neg\phi) \wedge (\neg utter_{ab}(\neg\ \sigma) \Rightarrow E_a \neg B_b \neg\phi)$
- $INDSQO_{ab}(\sigma,\phi) = B_a \neg\phi \wedge I_a \neg B_b \neg\phi$
  $\wedge B_a B_b(\neg\sigma \supset \neg\phi) \wedge (\neg utter_{ab}(\neg\sigma) \Rightarrow F_a \neg B_b \neg\phi\ )$

DO v.s. Intended DO (IDO)

When $\phi \equiv \sigma$, IDO is simplified as

- $IPDSO_{ab}(\sigma, \sigma) = PDSO_{ab}(\sigma) \wedge I_a B_b \sigma$
- $IPDSQO_{ab}(\sigma, \sigma) = PDSQO_{ab}(\sigma) \wedge I_a B_b \sigma$
- $INDSO_{ab}(\sigma, \sigma) = NDSO_{ab}(\sigma) \wedge I_a \neg B_b \neg \sigma$
- $INDSQO_{ab}(\sigma, \sigma) = NDSQO_{ab}(\sigma) \wedge I_a \neg B_b \neg \sigma$

Postulates for IDC and IDO

(IPDSC-IPDSO)

$B_a(IPDSC_{ab}(\sigma,\phi)) \wedge B_a(IPDSO_{ab}(\sigma,\phi)) \supset \neg IPDSC_{ab}(\sigma,\phi)$

(IPDSQC-IPDSQO)

$B_a(IPDSQC_{ab}(\sigma,\phi)) \wedge B_a(IPDSQO_{ab}(\sigma,\phi)) \supset \neg IPDSQC_{ab}(\sigma,\phi)$

(INDSC-INDSO)

$B_a(INDSC_{ab}(\sigma,\phi)) \wedge B_a(INDSO_{ab}(\sigma,\phi)) \supset \neg INDSC_{ab}(\sigma,\phi)$

(INDSQC-INDSQO)

$B_a(INDSQC_{ab}(\sigma,\phi)) \wedge B_a(INDSQO_{ab}(\sigma,\phi)) \supset \neg INDSQC_{ab}(\sigma,\phi)$

Three Types of Speech Acts

(John Austin: "How to do things with words". 1962)

- A locutionary act is the act of saying something. (ex. utterance)
- An illocutionary act is the act made in saying something. (ex. promise)
- A perlocutionary act is the act made by saying something. (ex. persuasion)

Lying

- Deception is a perlocutionary act that involves a success or an achievement of the act.
- By contrast, lying is *not* a perlocutionary act; whether or not an act of lying has occurred does not depend on whether or not a particular effect has been produced in another.
- Thus, deceiving differs from lying.

Lie v.s. Deception

- In "A logical account of lying" by Sakama, Caminada, and Herzig (JELIA 2010), lies are defined as

$$\mathrm{LIE}_{ab}(\sigma) = \mathrm{B}_a \neg\sigma \wedge \mathrm{I}_a \mathrm{B}_b \sigma \wedge \mathrm{utter}_{ab}(\sigma)$$

: "*a* lies to *b* on a sentence σ if *a* utters the believed-false sentence σ to *b* with the intention that σ is believed by *b*."

Lie v.s. Deception

- Comparing

$LIE_{ab}(\sigma) = B_a \neg\sigma \wedge I_a B_b \sigma \wedge utter_{ab}(\sigma)$

$IPDSC_{ab}(\sigma, \sigma) = B_a \neg\sigma \wedge I_a B_b \sigma \wedge (utter_{ab}(\sigma) \Rightarrow E_a B_b \sigma)$

$IPDSQC_{ab}(\sigma, \sigma) = B_a \neg\sigma \wedge I_a B_b \sigma \wedge (utter_{ab}(\sigma) \Rightarrow F_a B_b \sigma)$

the following implications hold:

- $IPDSC_{ab}(\sigma, \sigma) \supset LIE_{ab}(\sigma)$
- $IPDSQC_{ab}(\sigma, \sigma) \supset LIE_{ab}(\sigma)$

Withholding Information

- Withholding information is to fail to offer information that would help someone acquire true beliefs and/or correct false beliefs.
- Not all cases of withholding information constitute deception.

WI v.s. Deception

- Withholding infotmation (WI) is defined as

$$WI_{ab}(\sigma) = B_a \ulcorner\sigma \wedge I_a B_b \sigma \wedge \ulcorner\, utter_{ab}(\ulcorner\, \sigma)$$

: "*a* makes no utterance to *b* on a believed-true sentence $\ulcorner\sigma$ with the intention that σ is believed by *b*."

WI v.s. Deception

- Comparing

$WI_{ab}(\sigma) = B_a \neg\sigma \wedge I_a B_b \sigma \wedge \neg\, \text{utter}_{ab}(\neg\sigma)$

$IPDSO_{ab}(\sigma, \sigma) = B_a \neg\sigma \wedge I_a B_b \sigma \wedge$
$\wedge (\neg\, \text{utter}_{ab}(\neg\, \sigma) \Rightarrow E_a B_b \sigma)$

$IPDSQO_{ab}(\sigma, \sigma) = B_a \neg\sigma \wedge I_a B_b \sigma \wedge$
$\wedge (\neg\, \text{utter}_{ab}(\neg\, \sigma) \Rightarrow F_a B_b \sigma)$

the following implications hold:

- $IPDSO_{ab}(\sigma, \sigma) \supset WI_{ab}(\sigma)$
- $IPDSQO_{ab}(\sigma, \sigma) \supset WI_{ab}(\sigma)$

Action Logic is Nonmonotonic

- Action logic is nonmonotonic in the sense that an agent does not necessarily bring about all the consequences of his/her actions.

- So the following inference rules do not hold in general:

$$\frac{\phi \supset \Psi}{E_a\phi \supset E_a\Psi} \qquad \frac{\phi \supset \Psi}{F_a\phi \supset F_a\Psi}$$

Nonmonotonicity in Deception

- Deception based on action logic is thereby nonmonotonic. For instance, $PDSC_{ab}(\sigma)$ implies $E_aB_b\sigma$, but $E_aB_b\sigma$ and $B_a\sigma \supset \neg B_a\neg\sigma$ do not imply $E_a\neg B_a\neg\sigma$.
- By this fact, $PDSC_{ab}(\sigma)$ does not imply $NDSC_{ab}(\sigma)$.
- Positive deception does not imply negative deception in general.

Nonmonotonicity in Deception

- "Truth, lies and bullshit, distinguishing classes of dishonesty" by Caminada (SS@IJCAI,2009) studies another type of deception introduced by Adler (1997).
- A deceiver asserts what he/she believes true, while, at the same time, he/she conceals something of the truth hoping that a hearer will make an incorrect inference based on incomplete beliefs.
- For instance, if the speaker tells the believed-true statement that Tweety is a bird, while withholding the fact that Tweety is a penguin, then the hearer might yield the default conclusion that Tweety flies, which the speaker believes to be false.

Attempted Deception

- Caminada's notion of deception relies on the nonmonotonic inference capabilities of the hearer to reach a wrong conclusion.
- In [Sakama, Caminada, Herzig, JELIA 2010], it is formulated as

$$\begin{aligned} DEC_{ab}(\sigma,\delta) = {} & utter_{ab}(\sigma) \wedge B_a\sigma \wedge I_a B_b\sigma \\ & \wedge B_a B_b((\sigma \wedge \neg B_b \neg\delta) \supset \delta) \\ & \wedge B_a \neg B_b \neg\delta \wedge B_a \neg\delta \\ & \wedge \neg\, utter_{ab}(\neg\delta) \wedge I_a B_b \delta \end{aligned}$$

- By the definition, $DEC_{ab}(\sigma,\delta)$ implies $WI_{ab}(\delta)$.
- It does not describe the effect of deception, and is distinguished as attempted deception.

Intended Deception, Attempted Deception, Lying and Withholding Information