Logical Dynamics of Speech Acts in Social Communication

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Outline

The gap

Van Benthem & Liu (2007) on commanding

For instance, intuitively, a command

"See to it that φ!"

makes worlds where φ holds preferred over those where it does not - at least, if we accept the preference induced by the issuer of the command.

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Austin's Distinction (1955, pp.101-3.)

Locutionary Act

He said to me "Shoot her!" meaning by 'shoot' shoot and referring by 'her' to her.

Illocutionary Act

He urged (advised, ordered, etc.) me to shoot her.

Perlocutionary Act

(a) He persuaded me to shoot her.
(b) He got me to shoot her.

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- If the notion of speech act is to be taken seriously, it must be possible to treat speech acts as acts.
- If we succeed in characterizing speech acts in terms of dynamic changes they bring about, it becomes possible to treat them within a general theory of action.
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They are recognized only when their effects are recognized.

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- He then argued that there are many other illocutionary acts that do not seem to be dependent on any such special extralinguistic conventions.
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Conventional effects vs. utterers' intentions

- Strawson and his followers tried to characterize uses of sentences not in terms of conventional effects, but in terms of utterers' intentions to produce various effects in addressees along the lines initiated by Grice (1957).
- Utterers' intentions, however, usually go beyond illocutionary acts by involving reference to perlocutionary effects, while illocutionary acts can be effective even if they failed to produce intended perlocutionary effects.

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- Searle criticized Grice (and Strawson) for treating meaning as "a matter of intending to perform a perlocutionary acts",
- but agreed with Strawson in seeing Austin's notion of conventional effect as an overgeneralization (1971 $\rightarrow$ 1979, p.7).
- Searle sees conventionality of illocutionary acts as a matter of meaning, and denied the distiction between locutionary acts and illocutionary acts.
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Beyond the securing of uptake

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- Indeed, even typical illocutionary acts such as acts of promising, which both Strawson and Searle see not conventional in what they take to be Austin's sense, seem to involve more than the mere securing of uptake.
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What Austin's Earlier Answer Enables us to See

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Since perlocutionary acts are acts that really produce real effects, they cannot be completed without really producing them.

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Illocutionary acts are completed when the "mere conventional" effects are produced.

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The problem

- Is it possible to develop this conception of illocutionary acts into a general theory of illocutionary acts?
- In order to do so, we have to
  - specify conventional effects of a sufficiently rich variety of illocutionary acts, and
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The plan

- The recent development of Dynamic Epistemic Logics suggests a recipe for developing logics that can capture effects of various speech acts.
- We have developed dynamic logics that can deal with acts of commanding, promising, asserting, conceding, withdrawing, requesting, and acts of asking yes-no questions according to this recipe (Yamada 07a, 07b, 08a, 08b, 12, to appear).
- We will briefly review these developments.
- We will then discuss further research possibilities.

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The developments of dynamic epistemic logics

$[\varphi!]K_i\psi$

Dynamic Epistemic Logics DEL

adding dynamic modalities ↑ ↓ translation along reduction axioms

Multi-agent Epistemic Logics EL

$K_i\varphi$

Cf. Plaza (1989), Gerbrandy & Groeneveld (1997), Gerbrandy (1999), Baltag, Moss, & Solecki (1999), Kooi & van Benthem (2004), van Ditmarsch, Kooi, and van der Hoek (2007)

Two points to be noted

The formulas of the form $\varphi \to [\varphi!]K_i\varphi$ are shown to be valid for any $i \in I$ if no operators of the form K_i occur in φ.

- This is too strong for interpreting natural language public announcements.
- A gap similar to the one we have seen is also present here.

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The recipe (Yamada, 2012)

1. Carefully identify the aspects affected by the speech acts you want to study
2. find the modal logic that characterizes these aspects
3. add dynamic modalities that represent types of those speech acts
4. expand truth definition by adding clauses that interpret the speech acts under study as what update the very aspects
5. (if possible) find a complete set of reduction axioms for the resulting dynamic logic.

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This recipe works for acts of commanding (Yamada, 2007a)

$[!_i\varphi]O_i\psi$

Eliminative Command Logic ECL

adding dynamic modalities ↑ ↓ translation along reduction axioms

Multi-agent Deontic Logic MDL$^+$

$O_i\varphi$

The language of multi-agent deontic logic

Definition

Take a countably infinite set Aprop of proposition letters and a finite set I of agents, with p ranging over Aprop and i over I. The multi-agent monadic deontic language $\mathcal{L}_{\mathrm{MDL}^+}$ is given by:

$$\varphi ::= \top \mid p \mid \neg\varphi \mid \varphi \wedge \psi \mid \Box\varphi \mid O_i\varphi$$

$O_a\varphi$ It is obligatory upon an agent a to see to it that φ.

$P_a\varphi$ $\neg O_a \neg\varphi$.

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$\mathcal{L}_{\text{MDL}^+}$-models

Definition

By an $\mathcal{L}_{\text{MDL}^+}$-model, we mean a tuple
$M = \langle W^M, A^M, \{D_i^M \mid i \in I\}, V^M \rangle$ where:

(i) W^M is a non-empty set (heuristically, of 'possible worlds'),

(ii) $A^M \subseteq W^M \times W^M$,

(iii) $D_i^M \subseteq \Rightarrow^M$ for each $i \in I$,

(iv) V^M is a function that assigns a subset $V^M(p)$ of W^M to each proposition letter $p \in Aprop$.

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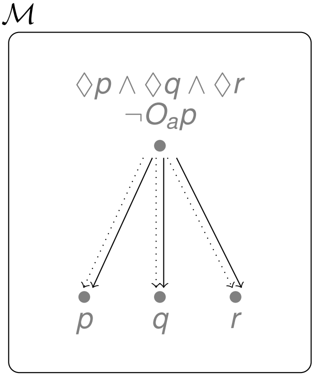
Example 1: on a hot day in a shared office



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q The air conditioner is running.

r The temperature is rising.

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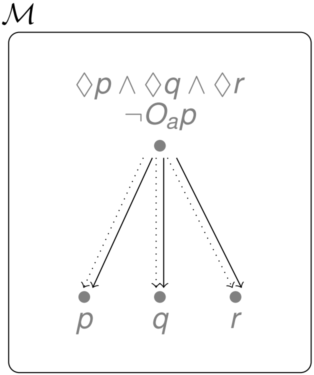

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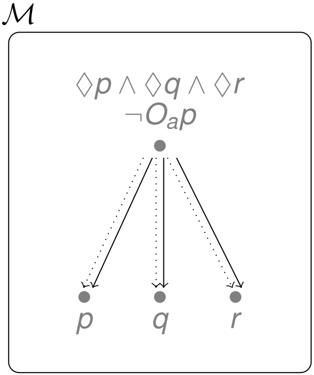

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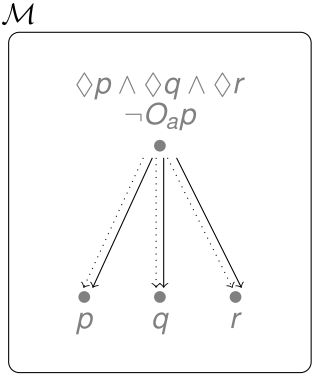

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The language of command logic

Definition

Take the same countably infinite set *Aprop* of proposition letters and the same finite set *I* of agents as before, with *p* ranging over *Aprop*, and *i* over *I*. The language $\mathcal{L}_{\text{ECL}}$ of eliminative command logic ECL is given by:

$$\varphi ::= \top \mid p \mid \neg\varphi \mid \varphi \wedge \psi \mid \Box\varphi \mid O_i\varphi \mid [\pi]\varphi$$
$$\pi ::= !_i\varphi$$

$[!_a\psi]O_a\varphi$ After every effective act of commanding an agent *a* to see to it that ψ, it is obligatory upon *a* to see to it that φ.

The truth definition for $\mathcal{L}_{\mathrm{ECL}}$

Definition

Let M be an $\mathcal{L}_{\mathrm{MDL}^+}$-model and w a point in M. If $p \in Aprop$, and $i \in I$, then the truth definition for $\mathcal{L}_{\mathrm{ECL}}$ is given by expanding that of $\mathcal{L}_{\mathrm{MDL}^+}$ mutatis mutandis with the following new clause:

$$\text{(g)} \quad M, w \models_{\mathrm{ECL}} [!_i\chi]\varphi \text{ iff } M_{!_i\chi}, w \models_{\mathrm{ECL}} \varphi \ ,$$

where $M_{!_i\chi}$ is the $\mathcal{L}_{\mathrm{MDL}^+}$-model obtained from M by replacing D_i^M with $\{\langle x, y\rangle \in D_i^M \mid M, y \models_{\mathrm{ECL}} \chi\}$.

The truth definition for $\mathcal{L}_{\text{ECL}}$

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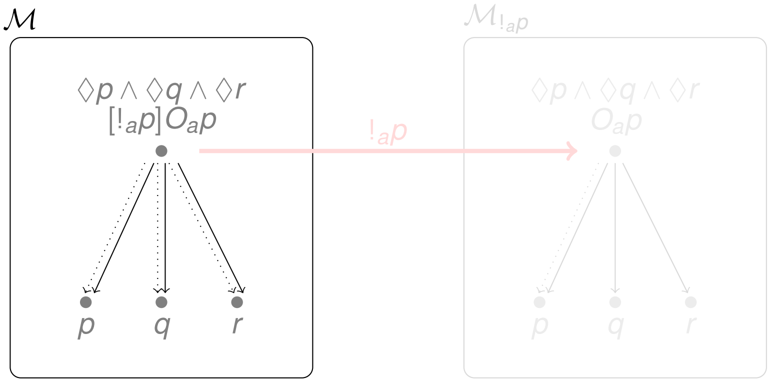
Your boss's act of commanding in ECL



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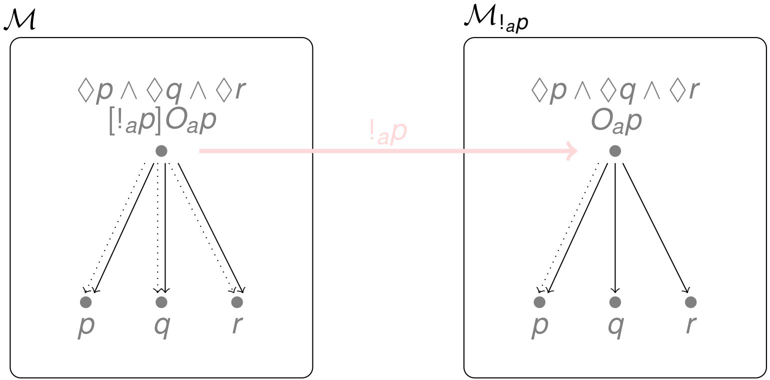

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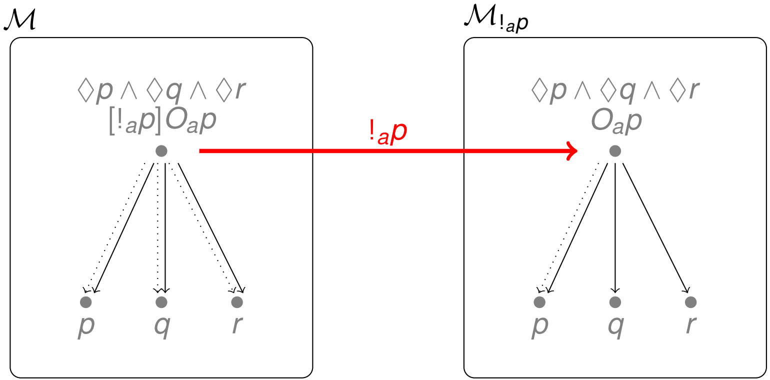

Some interesting principles

CUGO Ptrinciple

If φ is a formula of $\mathcal{L}_{\text{MDL}^+}$ and is free of occurrences of modal formulas of the form O_i, then $[!_i\varphi]O_i\varphi$ is valid.

Dead End Principles

$[!_i(\varphi \wedge \neg\varphi)]O_i\psi$ is valid.

Restricted Sequential Conjunction

If φ and ψ are formulas of $\mathcal{L}_{\text{MDL}^+}$ and are free of occurrences of modal formulas of the form O_i, then $[!_i\varphi][!_i\psi]\chi \leftrightarrow [!_i(\varphi \wedge \psi)]\chi$ is valid.

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The proof system for ECL

Definition

The proof system for ECL includes all the axioms and all the rules of the proof system for MDL$^+$, and in addition, the following rule and axioms:

(!-nec) $$\frac{\psi}{[!_i\varphi]\psi}$$ (for each $i \in I$)

(To be continued)

The proof system for ECL (continued)

Continued

(!1)	$[!_i\varphi]p$	$\leftrightarrow$	p	
(!2)	$[!_i\varphi]\top$	$\leftrightarrow$	$\top$	
(!3)	$[!_i\varphi]\neg\psi$	$\leftrightarrow$	$\neg[!_i\varphi]\psi$	
(!4)	$[!_i\varphi](\psi \wedge \chi)$	$\leftrightarrow$	$[!_i\varphi]\psi \wedge [!_i\varphi]\chi$	
(!5)	$[!_i\varphi]\Box\psi$	$\leftrightarrow$	$\Box[!_i\varphi]\psi$	
(!6)	$[!_i\varphi]O_j\psi$	$\leftrightarrow$	$O_j[!_i\varphi]\psi$	$(i \neq j)$
(!7)	$[!_i\varphi]O_i\psi$	$\leftrightarrow$	$O_i(\varphi \rightarrow [!_i\varphi]\psi)$	

Translation from $\mathcal{L}_{\mathrm{ECL}}$ to $\mathcal{L}_{\mathrm{MDL}^+}$

Definition

$$
\begin{aligned}
t(p) &= p & t([!_i\varphi]p) &= p \\
t(\top) &= \top & t([!_i\varphi]\top) &= \top \\
t(\neg\varphi) &= \neg t(\varphi) & t([!_i\varphi]\neg\psi) &= \neg t([!_i\varphi]\psi) \\
t(\varphi \wedge \psi) &= t(\varphi) \wedge t(\psi) & t([!_i\varphi](\psi \wedge \chi)) &= t([!_i\varphi]\psi) \wedge t([!_i\varphi]\chi) \\
t(\Box\varphi) &= \Box t(\varphi) & t([!_i\varphi]\Box\psi) &= \Box t([!_i\varphi]\psi) \\
t(O_i\varphi) &= O_i t(\varphi) & t([!_i\varphi]O_j\psi) &= O_j t([!_i\varphi]\psi) \quad (i \neq j) \\
& & t([!_i\varphi]O_i\psi) &= O_i(t(\varphi) \rightarrow t([!_i\varphi]\psi)) \\
& & t([!_i\varphi][!_j\psi]\chi) &= t([!_i\varphi]t([!_j\psi]\chi)) \\
& & & \text{(for any } j \in I)
\end{aligned}
$$

Some results (Yamada, 2007a)

Theorem

There is a complete axiomatization of ECL.

1. Introduction
2. DEL and A dynamic logic of acts of commanding
3. Refinements and Variations
   - Conflicting commands
   - Acts of commanding and promising
   - Assertions, concessions and their withdrawals
4. Combining logics
   - Obligations and preferences
   - The securing of uptake
   - Acts of requesting
   - Acts of asking yes-no questions
5. Concluding remarks

Contradictory commands from two distinct authorities

A dilemma

$$[!_{(a,b)}p][!_{(a,c)}\neg p](O_{(a,b)}p \land O_{(a,c)}\neg p) \quad .$$

Note that this does not lead to deontic explosion.

Example 2: Conflicting commands from your boss and your guru

A contingent dilemma

$$[!_{(a,b)}p][!_{(a,c)}q](O_{(a,b)}p \wedge O_{(a,c)}q) \wedge \neg(p \wedge q) \quad .$$

- p You will attend the conference in São Paulo on 11 June 2012.
- q You will join the demonstration in Sapporo on 11 June 2012.

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Some results (Yamada, 2007b)

CUGO Principle

If φ is a formula of $\mathrm{MDL}^{+}\mathrm{II}$ and is free of modal operators of the form $O_{(i,j)}$, $[!_{(i,j)}\varphi]O_{(i,j)}\varphi$ is valid.

Theorem

There is a complete axiomatization of ECLII.

Some results (Yamada, 2007b)

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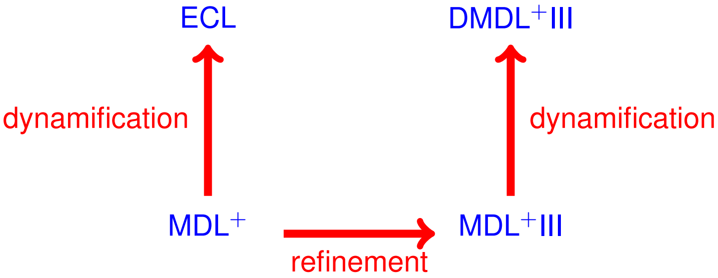
Theorem

There is a complete axiomatization of ECLII.

A further refinement and extension (Yamada 2008a)

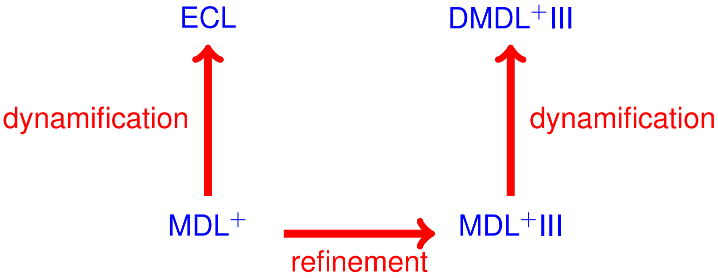


$O_{(i,j,k)}\varphi$ It is obligatory upon an agent i with respect to an obligee j in the name of k to see to it that φ.

$Com_{(i,j)}\varphi$ Act of commanding.

$Prom_{(i,j)}\varphi$ Act of promising.

A further refinement and extension (Yamada 2008a)



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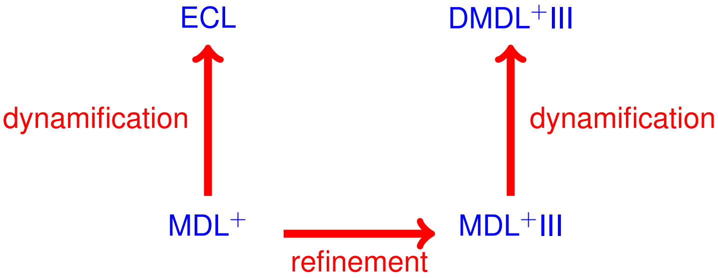

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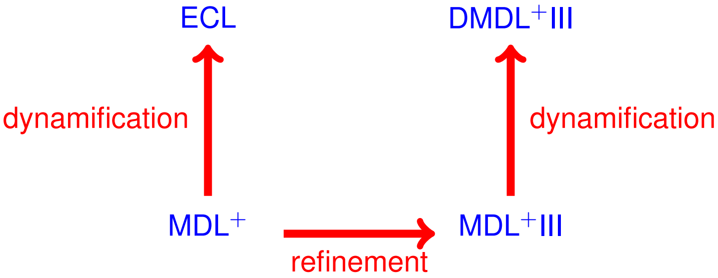

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Example 3: a command and a promise can lead to a dilemma

A contingent dilemma

$$[Prom_{(a,b)}p][Com_{(c,a)}q](O_{(a,b,a)}p \wedge O_{(a,c,c)}q) \wedge \neg(p \wedge q) \quad .$$

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Some results (Yamada, 2008a)

CUGO Principle

If φ is a formula of MDL^{+}III and is free of modal operators of the form $O_{(j,i,i)}$, $[Com_{(i,j)}\varphi]O_{(j,i,i)}\varphi$ is valid.

PUGO Principle

If φ is a formula of MDL^{+}III and is free of modal operators of the form $O_{(i,j,i)}$, $[Prom_{(i,j)}\varphi]O_{(i,j,i)}\varphi$ is valid.

Theorem

There is a complete axiomatization of DMDL^{+}III.

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The same recipe works for acts of asserting and conceding (Yamada, 2012)

Dynamified Multiagent Propositional Commitment Logic

DMPCL

adding dynamic modalities ↑ ↓ translation along reduction axioms

MPCL

Multi-agent Propositional Commitment Logic

Walton & Krabbe (1995)

Three Kinds of propositional commitments

- commitments incurred by making concessions
- commitments called assertions
- participant's dark-side commitments

Since dark-side commitments are hidden commitments and supposed to be fixed, we will ignore them.

We call the remaining two kinds of commitments c-commitments and a-commitments respectively.

Walton & Krabbe (1995)

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A-commitments and c-commitments

According to Walton and Krabbe (1995, p.186)

Propositional commitments constitute a special case of commitments to a course of action.

- an agent who has an a-commitment to the proposition p is obliged to defend it if the other party in the dialogue require her to justify it
- an agent who has a c-commitments to p is only obliged to allow the other party to use it in the arguments.

As anyone who asserts that p will be obliged to allow the other party to use it in the arguments, a-commitments imply c-commitments.

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The language of MPCL

Definition

Take a countably infinite set *Aprop* of proposition letters, and a finite set *I* of agents, with *p* ranging over *Aprop*, and *i* over *I*. The language $\mathcal{L}_{\text{MPCL}}$ of the multi-agent propositional commitment logic MPCL is given by:

$$\varphi ::= \top \mid p \mid \neg\varphi \mid \varphi \wedge \psi \mid [a\text{-}cmt]_i\varphi \mid [c\text{-}cmt]_i\varphi$$

$[\text{a-cmt}]_i\varphi$: an agent *i* has an a-commitment to the proposition φ,
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P-commitments are different from knowledge

The following formulas are not valid.

$[\text{a-cmt}]_i\varphi \rightarrow \varphi$

$[\text{c-cmt}]_i\varphi \rightarrow \varphi$

Cf. $K_i\varphi \rightarrow \varphi$

P-commitments are different from belief

The following formulas are not valid.

$\neg[\text{a-cmt}]_i\bot$

$\neg[\text{c-cmt}]_i\bot$

Cf. $\neg B_i\bot$

$\mathcal{L}_{\text{MPCL}}$-models

Definition

By an $\mathcal{L}_{\text{MPCL}}$-model, we mean a tuple $M = \langle W^M, \{\triangleright_i^M \mid i \in I\}, \{\blacktriangleright_i^M \mid i \in I\}, V^M\rangle$ where:

(i) W^M is a non-empty set (heuristically, of 'possible worlds'),

(ii) $\triangleright_i^M \subseteq W^M \times W^M$ for each $i \in I$,

(iii) $\blacktriangleright_i^M \subseteq \triangleright_i^M$ for each $i \in I$,

(iv) V^M is a function that assigns a subset $V^M(p)$ of W^M to each proposition letter $p \in \mathrm{Aprop}$.

Truth definition for $\mathcal{L}_{\text{MPCL}}$ (crucial part)

In addition to the standard clauses for proposition letters and Boolean operations, we need:

(e) $M, w \models_{\text{MPCL}} [a\text{-}cmt]_i\varphi$ iff for every v such that $\langle w, v\rangle \in \triangleright_i^M$, $M, v \models_{\text{MPCL}} \varphi$

(f) $M, w \models_{\text{MPCL}} [c\text{-}cmt]_i\varphi$ iff for every v such that $\langle w, v\rangle \in \blacktriangleright_i^M$, $M, v \models_{\text{MPCL}} \varphi$

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The Proof system for MPCL

Definition

The proof system for MPCL includes (i) all instantiations of propositional tautologies over the present language, (ii) K-axioms for $[\text{a-cmt}]_i$-modality and $[\text{c-cmt}]_i$-modality for each $i \in I$, (iii) modus ponens, and (iv) necessitation rules for $[\text{a-cmt}]_i$-modality and $[\text{c-cmt}]_i$-modality for each $i \in I$, in addition to the axiom of the following form for each $i \in I$:

$$\text{(Mix)} \quad [a\text{-}cmt]_i\varphi \to [c\text{-}cmt]_i\varphi$$

Theorem (Completeness of MPCL)

MPCL *is strongly complete with respect to* $\mathcal{L}_{\text{MPCL}}$*-models.*

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Theorem (Completeness of MPCL)

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Closure

Propositional commitments are closed with respect to the logical consequence.

$$([a\text{-}cmt]_i\varphi \wedge [a\text{-}cmt]_i(\varphi \to \psi)) \to [a\text{-}cmt]_i\psi$$

$$([c\text{-}cmt]_i\varphi \wedge [c\text{-}cmt]_i(\varphi \to \psi)) \to [c\text{-}cmt]_i\psi$$

Rational agents should withdraw at least one of their assertions or concessions if some unwanted consequences are derived from what they have explicitly asserted or conceded.

They are taken to be responsible for the logical consequences of what they have said at least to this extent.

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The language of DMPCL

Definition

Take the same countably infinite set *Aprop* of proposition letters and the same finite set *I* of agents as before, with *p* ranging over *Aprop*, and *i* over *I*. The language $\mathcal{L}_{\text{DMPCL}}$ of dynamified multi-agent propositional commitment logic DMPCL is given by:

$$\begin{aligned} \varphi \quad &::= \quad \top \mid p \mid \neg\varphi \mid \varphi \wedge \psi \mid [\textit{a-cmt}]_i\varphi \mid [\textit{c-cmt}]_i\varphi \mid [\pi]\varphi \\ \pi \quad &::= \quad \textit{assert}_i\varphi \mid \textit{concede}_i\varphi \end{aligned}$$

The truth definition for $\mathcal{L}_{\mathrm{DMPCL}}$

Definition

Let M be an $\mathcal{L}_{\mathrm{MPCL}}$-model and w a point in M. If $p \in Aprop$, and $i \in I$, then the truth definition for $\mathcal{L}_{\mathrm{DMPCL}}$ is given by expanding that of $\mathcal{L}_{\mathrm{MPCL}}$ mutatis mutandis with the following new clause:

(g) $M, w \models_{\mathrm{DMPCL}} [assert_i \chi]\varphi$ iff $M_{\mathrm{assert}_i \chi}, w \models_{\mathrm{DMPCL}} \varphi$

(h) $M, w \models_{\mathrm{DMPCL}} [concede_i \chi]\varphi$ iff $M_{\mathrm{concede}_i \chi}, w \models_{\mathrm{DMPCL}} \varphi$,

where $M_{\mathrm{assert}_i \chi}$ is the $\mathcal{L}_{\mathrm{MPCL}}$-model obtained from M by replacing $\rhd_i^M$ with $\{\langle x, y\rangle \in \rhd_i^M \mid M, y \models_{\mathrm{DMPCL}} \chi\}$ and $\blacktriangleright_i^M$ with $\{\langle x, y\rangle \in \blacktriangleright_i^M \mid M, y \models_{\mathrm{DMPCL}} \chi\}$,
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Definition

Let M be an $\mathcal{L}_{\text{MPCL}}$-model and w a point in M. If $p \in Aprop$, and $i \in I$, then the truth definition for $\mathcal{L}_{\text{DMPCL}}$ is given by expanding that of $\mathcal{L}_{\text{MPCL}}$ mutatis mutandis with the following new clause:

$$\begin{array}{lll} \text{(g)} & M, w \models_{\text{DMPCL}} [assert_i \chi]\varphi & \text{iff } M_{\text{assert}_i \chi}, w \models_{\text{DMPCL}} \varphi \\ \text{(h)} & M, w \models_{\text{DMPCL}} [concede_i \chi]\varphi & \text{iff } M_{\text{concede}_i \chi}, w \models_{\text{DMPCL}} \varphi \end{array},$$

where $M_{\text{assert}_i \chi}$ is the $\mathcal{L}_{\text{MPCL}}$-model obtained from M by replacing $\rhd_i^M$ with $\{\langle x, y\rangle \in \rhd_i^M \mid M, y \models_{\text{DMPCL}} \chi\}$ and $\blacktriangleright_i^M$ with $\{\langle x, y\rangle \in \blacktriangleright_i^M \mid M, y \models_{\text{DMPCL}} \chi\}$, and $M_{\text{concede}_i \chi}$ is the $\mathcal{L}_{\text{MPCL}}$-model obtained from M by replacing $\blacktriangleright_i^M$ with $\{\langle x, y\rangle \in \blacktriangleright_i^M \mid M, y \models_{\text{DMPCL}} \chi\}$.

The proof system for $\mathcal{L}_{\text{DMPCL}}$

Definition

The proof system for DMPCL includes all the axioms and all the rules of the proof system for MPCL, and in addition, necessitation rules for assertion modality and concession modality for each $i \in I$, and the following axioms:

(A1)	$[\text{assert}_i\varphi]p$	$\leftrightarrow$	p	
(A2)	$[\text{assert}_i\varphi]\top$	$\leftrightarrow$	$\top$	
(A3)	$[\text{assert}_i\varphi]\neg\psi$	$\leftrightarrow$	$\neg[\text{assert}_i\varphi]\psi$	
(A4)	$[\text{assert}_i\varphi](\psi \wedge \chi)$	$\leftrightarrow$	$[\text{assert}_i\varphi]\psi \wedge [\text{assert}_i\varphi]\chi$	
(A5)	$[\text{assert}_i\varphi][a\text{-}cmt]_j\psi$	$\leftrightarrow$	$[a\text{-}cmt]_j[\text{assert}_i\varphi]\psi$	$(i \neq j)$
(A6)	$[\text{assert}_i\varphi][a\text{-}cmt]_i\psi$	$\leftrightarrow$	$[a\text{-}cmt]_i(\varphi \to [\text{assert}_i\varphi]\psi)$	
(A7)	$[\text{assert}_i\varphi][c\text{-}cmt]_j\psi$	$\leftrightarrow$	$[c\text{-}cmt]_j[\text{assert}_i\varphi]\psi$	$(i \neq j)$
(A8)	$[\text{assert}_i\varphi][c\text{-}cmt]_i\psi$	$\leftrightarrow$	$[c\text{-}cmt]_i(\varphi \to [\text{assert}_i\varphi]\psi)$	
(C1)	$[\text{concede}_i\varphi]p$	$\leftrightarrow$	p	
(C2)	$[\text{concede}_i\varphi]\top$	$\leftrightarrow$	$\top$	
(C3)	$[\text{concede}_i\varphi]\neg\psi$	$\leftrightarrow$	$\neg[\text{concede}_i\varphi]\psi$	
(C4)	$[\text{concede}_i\varphi](\psi \wedge \chi)$	$\leftrightarrow$	$[\text{concede}_i\varphi]\psi \wedge [\text{concede}_i\varphi]\chi$	
(C5)	$[\text{concede}_i\varphi][a\text{-}cmt]_j\psi$	$\leftrightarrow$	$[a\text{-}cmt]_j[\text{concede}_i\varphi]\psi$	(for any j)
(C6)	$[\text{concede}_i\varphi][c\text{-}cmt]_j\psi$	$\leftrightarrow$	$[c\text{-}cmt]_j[\text{concede}_i\varphi]\psi$	$(i \neq j)$
(C7)	$[\text{concede}_i\varphi][c\text{-}cmt]_i\psi$	$\leftrightarrow$	$[c\text{-}cmt]_i(\varphi \to [\text{concede}_i\varphi]\psi)$	

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Translation from $\mathcal{L}_{\text{DMPCL}}$ to $\mathcal{L}_{\text{MPCL}}$

Definition

The translation function that takes a formula from $\mathcal{L}_{\text{DMPCL}}$ and yields a formula in $\mathcal{L}_{\text{MPCL}}$ is defined as follows:

$$
\begin{array}{llll}
t(p) & = p & t([\text{assert}_i\varphi]p) & = p \\
 & & t([\text{concede}_i\varphi]p) & = p \\
t(\top) & = \top & t([\text{assert}_i\varphi]\top) & = \top \\
 & & t([\text{concede}_i\varphi]\top) & = \top \\
t(\neg\varphi) & = \neg t(\varphi) & t([\text{assert}_i\varphi]\neg\psi) & = \neg t([\text{assert}_i\varphi]\psi) \\
 & & t([\text{concede}_i\varphi]\neg\psi) & = \neg t([\text{concede}_i\varphi]\psi) \\
t(\varphi\wedge\psi) & = t(\varphi)\wedge t(\psi) & t([\text{assert}_i\varphi](\psi\wedge\chi)) & = t([\text{assert}_i\varphi]\psi)\wedge t([\text{assert}_i\varphi]\chi) \\
 & & t([\text{concede}_i\varphi](\psi\wedge\chi)) & = t([\text{concede}_i\varphi]\psi)\wedge t([\text{concede}_i\varphi]\chi) \\
t([\textit{a-cmt}]_i\varphi) & = [\textit{a-cmt}]_i t(\varphi) & t([\text{assert}_i\varphi][\textit{a-cmt}]_j\psi) & = [\textit{a-cmt}]_j t([\text{assert}_i\varphi]\psi) \quad (i\neq j) \\
 & & t([\text{assert}_i\varphi][\textit{a-cmt}]_i\psi) & = [\textit{a-cmt}]_i t(\varphi\rightarrow[\text{assert}_i\varphi]\psi) \\
 & & t([\text{concede}_i\varphi][\textit{a-cmt}]_j\psi) & = [\textit{a-cmt}]_j t([\text{concede}_i\varphi]\psi) \\
t([\textit{c-cmt}]_i\varphi) & = [\textit{c-cmt}]_i t(\varphi) & t([\text{assert}_i\varphi][\textit{c-cmt}]_j\psi) & = [\textit{c-cmt}]_j t([\text{assert}_i\varphi]\psi) \quad (i\neq j) \\
 & & t([\text{assert}_i\varphi][\textit{c-cmt}]_i\psi) & = [\textit{c-cmt}]_i t(\varphi\rightarrow[\text{assert}_i\varphi]\psi) \\
 & & t([\text{concede}_i\varphi][\textit{c-cmt}]_j\psi) & = [\textit{c-cmt}]_j t([\text{concede}_i\varphi]\psi) \quad (i\neq j) \\
 & & t([\text{concede}_i\varphi][\textit{c-cmt}]_i\psi) & = [\textit{c-cmt}]_i t(\varphi\rightarrow[\text{concede}_i\varphi]\psi) \\
 & & t([\text{assert}_i\varphi][\text{assert}_j\psi]\chi) & = t([\text{assert}_i\varphi]t([\text{assert}_j\psi]\chi)) \\
 & & t([\text{assert}_i\varphi][\text{concede}_j\psi]\chi) & = t([\text{assert}_i\varphi]t([\text{concede}_j\psi]\chi)) \\
 & & t([\text{concede}_i\varphi][\text{assert}_j\psi]\chi) & = t([\text{concede}_i\varphi]t([\text{assert}_j\psi]\chi)) \\
 & & t([\text{concede}_i\varphi][\text{concede}_j\psi]\chi) & = t([\text{concede}_i\varphi]t([\text{concede}_j\psi]\chi))
\end{array}
$$

Some results

Proposition

If $\varphi \in \mathcal{L}_{\text{MPCL}}$ is free of modalities indexed by i, the following formulas are valid:

$$[\text{assert}_i\varphi][\textit{a-cmt}]_i\varphi$$
$$[\text{assert}_i\varphi][\textit{c-cmt}]_i\varphi$$
$$[\text{concede}_i\varphi][\textit{c-cmt}]_i\varphi \quad .$$

Theorem

There is a complete axiomatization of DMPCL.

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Theorem

There is a complete axiomatization of DMPCL.

Does the same strategy work for acts of asserting and conceding combined with acts of withdrawing ?

Dynamified Multiagent Propositional Commitment Logic with withdrawals DMPCL^{+}

adding dynamic modalities ↑

↓ translation available ?

Multi-agent Propositional Commitment Logic MPCL

The language of DMPCL$^+$

Definition

Take the same countably infinite set *Aprop* of proposition letters and the same finite set *I* of agents as before, with *p* ranging over *Aprop*, and *i* over *I*. The language $\mathcal{L}_{\mathrm{DPCMT}^+}$ of dynamified multi-agent propositional commitment logic with withdrawals DMPCL$^+$ is given by:

$$\varphi \quad ::= \quad \top \mid p \mid \neg\varphi \mid \varphi \wedge \psi \mid [\textit{a-cmt}]_i\varphi \mid [\textit{c-cmt}]_i\varphi \mid [\pi]\varphi$$
$$\pi \quad ::= \quad \mathrm{assert}_i\varphi \mid \mathrm{concede}_i\varphi \mid \circlearrowleft\!\mathrm{assert}_i\varphi \mid \circlearrowleft\!\mathrm{concede}_i\varphi$$

An update by withdrawing?

A sequence of acts: $\ldots, \text{assert}_i\chi, \text{assert}_j\xi, \text{assert}_i\eta, \ldots$

$\Downarrow \quad \circlearrowleft\text{assert}_j\xi$

A reduced sequence: $\ldots, \text{assert}_i\chi, \text{assert}_i\eta, \ldots$

The set of propositional commitments agents bear after *j*'s act of withdrawing of the form $\circlearrowleft\text{assert}_j\xi$ will be, other things being equal, the same as the set of propositional commitments they would bear if *j* had not asserted that ξ.

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A positive commitment act sequence

If σ is a sequence of moves in an argumentation, it may involve not only acts of asserting and conceding but also acts of withdrawing. We call it a commitment affecting act sequence, or caa-sequence for short.

We will first consider a special kind of sequences, namely, a sequence $\sigma = \langle \pi_1, \pi_2, \cdots, \pi_n \rangle$ of speech acts π_j ($1 \leq j \leq n$) such that each π_j is either of the form $\mathrm{assert}_i\varphi$ for some $i \in I$ or of the form $\mathrm{concede}_i\varphi$ for some $i \in I$. We call such a sequence a positive commitment act sequence, or a pca-sequence for short.

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Reduced positive commitmment act sequence

Definition

Let σ be a (possibly empty) positive commitment act sequence $\langle \pi_1, \cdots, \pi_n \rangle$ such that each π_j ($1 \leq j \leq n$) is of the form $\mathrm{assert}_i\varphi$ for some $i \in I$ or of the form $\mathrm{concede}_i\varphi$ for some $i \in I$. We define the reduced sequence $\sigma \restriction \circlearrowleft \mathrm{assert}_i\varphi$ ($\sigma \restriction \circlearrowleft \mathrm{concede}_i\varphi$) obtained by withdrawing every occurrence of an act of type $\mathrm{assert}_i\varphi$ ($\mathrm{concede}_i\varphi$) from σ as follows:

(To be continued)

Reduced pca-sequence (continued)

$$\sigma \restriction \circlearrowleft \mathrm{assert}_i\varphi = \begin{cases} \sigma & \text{if } \sigma \text{ is empty} \\ \langle \pi_1, \cdots, \pi_{n-1} \rangle \restriction \circlearrowleft \mathrm{assert}_i\varphi & \text{if } \sigma = \langle \pi_1, \cdots, \pi_n \rangle, \text{ and } \pi_n = \mathrm{assert}_i\varphi \\ \langle \langle \pi_1, \cdots, \pi_{n-1} \rangle \restriction \circlearrowleft \mathrm{assert}_i\varphi, \pi_n \rangle & \text{if } \sigma = \langle \pi_1, \cdots, \pi_n \rangle, \text{ and } \pi_n \neq \mathrm{assert}_i\varphi \end{cases}$$

and

$$\sigma \restriction \circlearrowleft \mathrm{concede}_i\varphi = \begin{cases} \sigma & \text{if } \sigma \text{ is empty} \\ \langle \pi_1, \cdots, \pi_{n-1} \rangle \restriction \circlearrowleft \mathrm{concede}_i\varphi & \text{if } \sigma = \langle \pi_1, \cdots, \pi_n \rangle, \text{ and } \pi_n = \mathrm{concede}_i\varphi \\ \langle \langle \pi_1, \cdots, \pi_{n-1} \rangle \restriction \circlearrowleft \mathrm{concede}_i\varphi, \pi_n \rangle & \text{if } \sigma = \langle \pi_1, \cdots, \pi_n \rangle, \text{ and } \pi_n \neq \mathrm{concede}_i\varphi \text{ .} \end{cases}$$

How to work with arbitrary sequence

definition

Given an arbitrary caa-sequence σ possibly involving acts of withdrawing as well as acts of asserting and acts of conceding, we define its corresponding pca-sequence σ^* as follows:

$$\sigma^* = \begin{cases} \sigma & \text{if } \sigma \text{ is empty} \\ \langle\langle \pi_1, \cdots, \pi_{n-1}\rangle^*, \mathrm{assert}_i\varphi\rangle & \text{if } \sigma = \langle \pi_1, \cdots, \pi_n\rangle, \text{ and } \pi_n = \mathrm{assert}_i\varphi \\ \langle\langle \pi_1, \cdots, \pi_{n-1}\rangle^*, \mathrm{concede}_i\varphi\rangle & \text{if } \sigma = \langle \pi_1, \cdots, \pi_n\rangle, \text{ and } \pi_n = \mathrm{concede}_i\varphi \\ \langle\langle \pi_1, \cdots, \pi_{n-1}\rangle^* \upharpoonright \circlearrowleft\mathrm{assert}_i\varphi\rangle & \text{if } \sigma = \langle \pi_1, \cdots, \pi_n\rangle, \text{ and } \pi_n = \circlearrowleft\mathrm{assert}_i\varphi \\ \langle\langle \pi_1, \cdots, \pi_{n-1}\rangle^* \upharpoonright \circlearrowleft\mathrm{concede}_i\varphi\rangle & \text{if } \sigma = \langle \pi_1, \cdots, \pi_n\rangle, \text{ and } \pi_n = \circlearrowleft\mathrm{concede}_i\varphi \end{cases}.$$

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The Problem of Notation

Given a pca-sequence $\sigma = \langle \pi_1, \cdots, \pi_n \rangle$, the model obtained by updating M with σ is denoted by $(\ldots(M_{\pi_1})\ldots)_{\pi_n}$ in the notation of the truth definition for $\mathcal{L}_{\text{DMPCL}}$.

This notation leads to a paradox when we deal with withdrawals. Let abbreviate $(\ldots(M_{\pi_1})\ldots)_{\pi_n}$ as M_σ. Now there may be another model N and a pcs-sequence τ such that $N_\tau = M$. Then we might have

$(N_\tau)_\sigma = M_\sigma$ but $((N_\tau)_\sigma)_{\circlearrowleft \text{concede}_i \varphi} \neq (M_\sigma)_{\circlearrowleft \text{concede}_i \varphi}$.

Truth Definition 1/4

Definition

Let M be an $\mathcal{L}_{\text{MPCL}}$-model, σ an arbitrary caa-sequence, σ^* the corresponding pca-sequence of σ, and w a point in M. If $p \in Aprop$, and $i \in I$, then:

(a) $M, \sigma, w \models_{\text{DMPCL}^+} p$ iff $w \in V^M(p)$

(b) $M, \sigma, w \models_{\text{DMPCL}^+} \top$

(c) $M, \sigma, w \models_{\text{DMPCL}^+} \neg\varphi$ iff it is not the case that $M, \sigma, w \models_{\text{DMPCL}^+} \varphi$

(d) $M, \sigma, w \models_{\text{DMPCL}^+} (\varphi \wedge \psi)$ iff $M, \sigma, w \models_{\text{DMPCL}^+} \varphi$ and $M, \sigma, w \models_{\text{DMPCL}^+} \psi$

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Truth Definition 2/4

(e) $M, \sigma, w \models_{\mathrm{DMPCL}^+} [a\text{-}cmt]_i \varphi$ iff for all v s. t. $\langle w, v \rangle \in \triangleright_i^M \upharpoonright \sigma^*$, $M, \sigma^*, v \models_{\mathrm{DMPCL}^+} \varphi$

(f) $M, \sigma, w \models_{\mathrm{DMPCL}^+} [c\text{-}cmt]_i \varphi$ iff for all v s. t. $\langle w, v \rangle \in \blacktriangleright_i^M \upharpoonright \sigma^*$, $M, \sigma^*, v \models_{\mathrm{DMPCL}^+} \varphi$

(g) $M, \sigma, w \models_{\mathrm{DMPCL}^+} [\mathrm{assert}_i \chi] \varphi$ iff $M, \langle \sigma, \mathrm{assert}_i \chi \rangle, w \models_{\mathrm{DMPCL}^+} \varphi$

(h) $M, \sigma, w \models_{\mathrm{DMPCL}^+} [\mathrm{concede}_i \chi] \varphi$ iff $M, \langle \sigma, \mathrm{concede}_i \chi \rangle, w \models_{\mathrm{DMPCL}^+} \varphi$

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Truth Definition 2/4

(e) $M, \sigma, w \models_{\mathrm{DMPCL}^+} [\textit{a-cmt}]_i\varphi$ iff for all v s. t. $\langle w, v\rangle \in \rhd_i^M \upharpoonright \sigma^*$, $M, \sigma^*, v \models_{\mathrm{DMPCL}^+} \varphi$

(f) $M, \sigma, w \models_{\mathrm{DMPCL}^+} [\textit{c-cmt}]_i\varphi$ iff for all v s. t. $\langle w, v\rangle \in \blacktriangleright_i^M \upharpoonright \sigma^*$, $M, \sigma^*, v \models_{\mathrm{DMPCL}^+} \varphi$

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Truth Definition 3/4

(i) $M, \sigma, w \models_{\text{DMPCL}^+} [\circlearrowleft \text{assert}_i \chi]\varphi$ iff $M, \sigma^* \restriction \circlearrowleft \text{assert}_i \chi,$
$w \models_{\text{DMPCL}^+} \varphi$

(j) $M, \sigma, w \models_{\text{DMPCL}^+} [\circlearrowleft \text{concede}_i \chi]\varphi$ iff $M, \sigma^* \restriction \circlearrowleft \text{concede}_i \chi,$
$w \models_{\text{DMPCL}^+} \varphi$,

where $\triangleright_i^M \restriction \sigma$ and $\blacktriangleright_i^M \restriction \sigma$ are

Truth Definition 3/4

(i) $M, \sigma, w \models_{\text{DMPCL}^+} [\circlearrowleft \mathrm{assert}_i \chi]\varphi$ iff $M, \sigma^* \restriction \circlearrowleft \mathrm{assert}_i \chi,$
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Truth Definition 3/4

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$$\rhd_i^M\!\restriction\sigma^* = \begin{cases} \rhd_i^M \quad \text{if } \sigma^* \text{ is empty,} \\ \{\langle x, y\rangle \in \rhd_i^M\!\restriction\langle\pi_1,\ldots,\pi_{n-1}\rangle \mid M, \langle\pi_1,\ldots,\pi_{n-1}\rangle, y \models_{\text{DMPCL}^+} \psi\} \\ \qquad\qquad \text{if } \sigma^* = \langle\pi_1,\ldots,\pi_n\rangle \text{ and } \pi_n = \text{assert}_i\psi, \\ \rhd_i^M\!\restriction\langle\pi_1,\ldots,\pi_{n-1}\rangle \quad \text{if } \sigma^* = \langle\pi_1,\ldots,\pi_n\rangle \text{ and } \pi_n \neq \text{assert}_i\psi, \end{cases}$$

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A result and an open problem

A result

Acts of withdrawing behave slightly differently from contraction studied in belief revision. Let $\mathcal{B}$ be a set of beliefs of an agent, say a. Then in the AGM approach, contraction $\ominus$ is supposed to satisfy the postulate that $\varphi \notin \mathcal{B} \ominus \varphi$ if $\not\vdash \varphi$, but we have, for example, $M, \sigma \restriction \circlearrowleft \mathrm{assert}_a p, w \models_{\mathrm{DMPCL}^+} [\text{a-cmt}]_a p$ if σ include $\mathrm{assert}_a q$ and $\mathrm{assert}_a(q \rightarrow p)$.

An open problem

The completeness problem of DMPCL^+ is still open.

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An open problem

The completeness problem of DMPCL^+ is still open.

The same strategy works for changing preferences (van Benthem and Liu, 2007) (Liu, 2008)

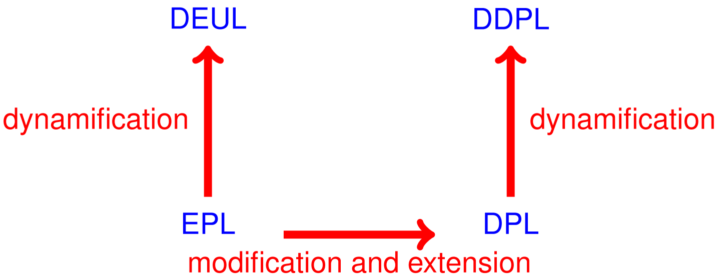
Dynamic Epistemic Upgrade Logic DEUL

↑ adding dynamic modalities

↓ translation along reduction axioms

Epistemic Preference Logic EPL

Combining preference upgrades and deontic updates (Yamada 2008b)



The language of DPL

Definition

Take a set *Aprop* of proposition letters, and a set *I* of agents, with *p* ranging over *Aprop* and i, j over *I*. The deontic preference language is given by:

$$\varphi ::= \bot \mid p \mid \neg\varphi \mid (\varphi \wedge \psi) \mid U\varphi \mid [pref]_i\varphi \mid O_{(i,j)}\varphi$$

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Some results (Yamada, 2008b)

Theorem

There is a complete axiomatization of DDPL.

The following formulas are satisfiable.

$O_{(i,j)}p \wedge U(p \rightarrow \langle pref \rangle_i \neg p)$.
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Austin on the securing of uptake

According to Austin, “the securing of uptake” means “bringing about the understanding of the meaning and of the force of the locution”. It is the “effect” that “must be achieved on the audience if the illocutionary act is to be carried out.” And so,“the performance of an illocutionary act involves the securing of uptake” (Austin, 1955, 117-118).

In the case of an act of commanding, the understanding of the force means the understanding of the commander’s locution as an act of commanding and the understanding of the meaning of her locution includes the understanding of what is commanded.

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The plan of DMEDL

$[Com_{(i,j)}\varphi]\psi$, $[Prom_{(i,j)}\varphi]\psi$, $[Req_{(i,j)}\varphi]\psi$

Dynamified Multi-agent Epistemic Deontic Logic DMEDL

↑ adding dynamic modalities

↓ translation along reduction axioms

Multi-agent Epistemic Deontic Logic MEDL

$O_{(i,j,k)}\varphi$, $K_i\psi$

The language of MEDL

We extend the language of $MDL^{+}III$ by adding an epistemic operator K_i for each agent $i \in I$.

$$\varphi ::= \top \mid p \mid \neg\varphi \mid \varphi \wedge \psi \mid O_{(i,j,k)}\varphi \mid K_i\varphi$$

For simplicity, we ignore alethic modality here.

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The models for MEDL

By an $\mathcal{L}_{\text{MEDL}}$-model, we mean a tuple $M = \langle W^M, \{E_i^M \mid i \in I\}, \{D^M_{(i,j,k)} \mid i,j,k \in I\}, V^M \rangle$ where:

(i) W^M is a non-empty set (heuristically, of 'possible worlds' or 'states')
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$$\pi \ ::= \ Com_{(i,j)}\varphi \mid Prom_{(i,j)}\varphi \mid Req_{(i,j)}\varphi$$

The formula of the form $[Req_{(i,j)}\varphi]\psi$ means that after an agent i's act of requesting j to see to it that φ, ψ holds.

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CUGO principle and CUGU principle (Yamada. to appear)

CUGO Principle

If φ is a formula of MEDL and is free of modal operators of the form $O_{(j,i,i)}$, $[Com_{(i,j)}\varphi]O_{(j,i,i)}\varphi$ is valid.

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If φ is a formula of MEDL and is free of modal operators of the form $O_{(j,i,i)}$, $[Com_{(i,j)}\varphi]K_jO_{(j,i,i)}\varphi$ is valid.

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Too strong?

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Preliminary analysis of the effects of acts of requesting

In the case of acts of requesting, but not in the case of acts of commanding, refusals are among legitimate responses. In this sense, an act of requesting does not generate an obligation to do what is requested.

But when you are requested to do something, it would not be fully unproblematic for you to ignore the request without giving any response. At least you have to decide whether you should accept the request or not, and let the requester know your decision.

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Preliminary analysis continued

If the requestee, say j, decides that she should do what is requested, and the requested action is not the kind of thing to be done on the spot, she can promise the requester i that she (j) will do what is requested. As the PUGU principle indicates, the requester i will know that $O_{(j,i,j)}\varphi$.

If the requestee j decides that she (j) should reject the request, she (j) should let the requester i know that $\neg O_{(j,i,j)}\varphi$.

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Now what about the case in which what is requested can be done on the spot. If the requestee *j* decides that she should do what is requested, she might do it on the spot without saying anything.

Whether we should count this as the third alternative way of responding to an act of requesting, or consider it as skipping to the sequel of an implicit promise might be a matter of opinion.

Traum (1999, 195), for example, includes only the options of accepting or refusing. In this paper we take the formulation with the three options.

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The effects of acts of requesting (Yamada. to appear)

The foregoing discussions sugget the following priciple.

RUGO Principle

If φ is a formula of MEDL$^+$III and is free of modal operators of the form $O_{(j,i,i)}$, formulas of the following form are valid:

$$[Req_{(i,j)}\varphi]O_{(j,i,i)}(\varphi \vee K_i O_{(j,i,j)}\varphi \vee K_i \neg O_{(j,i,j)}\varphi) \; .$$

It is easy to define semantics that supports this principle.

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Acts of requesting in DMEDL

Truth definition

$M, w \models [Req_{(i,j)}\varphi]\psi$ iff $M_{Req_{(i,j)}\varphi}, w \models \psi$,

where $M_{Req_{(i,j)}\varphi}$ is a model of DMEDL obtained from M by replacing deontic accessibility relation $D^M_{(j,i,i)}$ with its subset $\{\langle x, y\rangle \in D^M_{(j,i,i)} | M, y \models \varphi \vee K_i O_{(j,i,j)}\varphi \vee K_i \neg O_{(j,i,j)}\varphi\}$.

Requesting and commanding

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By CUGO principle, we also have:

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Equivalence?

$$M_{Req_{(i,j)}\varphi} = M_{Com_{(i,j)}(\varphi \vee K_i O_{(j,i,j)}\varphi \vee K_i \neg O_{(j,i,j)}\varphi)}$$

A difference

Seeing to it that $K_i \neg O_{(j,i,j)}\varphi$ is a way of refusing $Req(i,j)\varphi$. But it is not a way of refusing, but a way of obeying, $Com_{(i,j)}(\varphi \vee K_i O_{(j,i,j)}\varphi \vee K_i \neg O_{(j,i,j)}\varphi)$.

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Our analysis can be applied to the formalization of the notion of questions as requests for information in a straightforward manner. Thus we can define the term that represents the type of the acts in which i asks j whether φ is the case or not, $\textit{Ask-if}_{(i,j)}\varphi$, as an abbreviation for $\textit{Req}_{(i,j)}(K_i\varphi \vee K_i\neg\varphi)$.

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Concluding remarks

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Propositional modal logics are especially useful for developing a prototype of a formal theory of speech acts.

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