Count-as Conditionals in Channel Theory

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Outline

Formal approaches to count-as conditionals

Several attempts to capture the logic of count-as conditionals have been made in the deontic logic literature recently.

Grossi and Jones (2013) gives a succinct overview of the following works:
(1) Jones et al. (1996),
(2) Gelati et al. (2002, 2004),
(3) Grossi et al. (2005, 2006a, b, 2007, 2008),
(4) Lorini et al. (2008, 2009),
(5) Governatori et al. (2008),
(6) Boella et al. (2003, 2004, 2006),
(7) Lindahl et al. (2006, 2008a, b).

Some Earlier Works

Earlier works on the kind of regularity in question include:

- A. Goldman's discussion on conventional generation in *A Theory of Human Action* (1976),
- Discussions of conventional constraints in Barwise & Perry, *Situations and Attitudes* (1983), Keith Devlin, *Logic and Information* (1991), etc.

A problem

Count-as conditionals are introduced by John Searle (1969) as "constitutive rules" of the following form.

X counts as Y in context C.

I'm wondering whether the recent discussions pay enough attention to the distinction between concrete particular contexts in which entities or processes of type X count as Y and the common type C shared by such contexts.

The purpose of this paper is to show how this problem can be avoided by modeling contexts and actions done in them in channel theory of Barwise and Seligman (1997).

Why this is a problem?

In Grossi and Jones (2013, p.416), Jones and Sergot (1996) are said to represent count-as conditional as $\varphi_1 \Rightarrow_c \varphi_2$.

They proposed the following principle as one of the "minimal core of the logical principles for the logic of count-as" (Grossi et al. 2013, pp. 416-417. Cf. Jones and Sergot, 1996, pp. 436).

$$((\varphi_1 \Rightarrow_c \varphi_2) \wedge (\varphi_2 \Rightarrow_c \varphi_3)) \rightarrow (\varphi_1 \Rightarrow_c \varphi_3)$$

As Jones and Sergot (1996, p. 430) understand c as an institution, it is natural to think of c as fixed.

If c is understood just as an arbitrary context, however, we have to admit the possibility of a context being part of two or more institutions.

Iteration

Consider the following quotation from Searle (1995).

Making certain noises counts as uttering an English sentence, uttering a certain sort of English sentence in certain circumstance counts as entering into a contract, entering into certain sorts of contracts counts as getting married (Searle, 1995, p. 83).

Consider a particular context c_1 in which a person *a* gets married.

Iteration (2)

Here we can assume that c_1 is:

the context in which a's entering into a certain sort of contract counts as getting married.

But if so, it can also be

the context in which a's uttering a certain sort of English sentence counts as entering into a certain sort of contract

and similarly,

the context in which a's making certain noises counts as uttering an English sentence.

Context Tokens

Let Σ_1 be the set of all the contexts in which making of certain noises counts as uttering a particular English sentence S.

Let Σ_2 be the set of all the context in which uttering of that particular English sentence S counts as entering into a certain sort of contract.

Let Σ_3 be the set of all the context in which entering into that sort of contract counts as getting married

Now we can say:

$$c_1 \in \Sigma_3 \subsetneqq \Sigma_2 \subsetneqq \Sigma_1.$$

Context Types

Compare that with the following:

Performing such and such speech acts (the X term) in front of a presiding official (the C term) now counts as getting married (the Y term). Saying those very same words in a different context, while making love, for example, will not constitute getting married (Searle 1995, p. 82).

Here the C term seems to refer to a repeatable condition "in front of a presiding official".

A hierarchical structure

"We can impose status-functions on entities that have already had status-functions imposed on them. In such cases the X term at a higher level can be a Y term from an earlier level" (Searle 1995, p. 80).

$$\begin{array}{lllllll}
 & & & & & \dots & \\
 & & & & & \| & \\
 & & & & X_3 & \text{counts-as } Y_3 & \text{in } C_3 \\
 & & & & \| & & \\
 & & X_2 & \text{counts-as } Y_2 & \text{in } C_2 & & \\
 & & \| & & & & \\
X_1 & \text{counts-as } Y_1 & \text{in } C_1 & & & &
\end{array}$$

Two hierarchical structures

Now let us compare the following two hierarchical structures.

$$c_1 \in \Sigma_3 \subsetneqq \Sigma_2 \subsetneqq \Sigma_1.$$

$$\begin{array}{lllllll}
 & & & & & \dots & \\
 & & & & & \| & \\
 & & & & X_3 & \text{counts-as } Y_3 & \text{in } C_3 \\
 & & & & \| & & \\
 & & X_2 & \text{counts-as } Y_2 & \text{in } C_2 & & \\
 & & \| & & & & \\
X_1 & \text{counts-as } Y_1 & \text{in } C_1 & & & &
\end{array}$$

Suppose $\Sigma_1 = \{x : x \text{ is of type } C_1\}$, etc. Then we have

c_1 is of type C_1, of type C_2 and of type C_3.

But we can also say:

C_1, C_2 and C_3 are distinct from each other.

What channel theory enables us to do

$$\begin{array}{lllllll}
 & & & & & \dots & \\
 & & & & & \| & \\
 & & & & X_3 & \text{counts-as } Y_3 & \text{in } C_3 \\
 & & & & \| & & \\
 & & X_2 & \text{counts-as } Y_2 & \text{in } C_2 & & \\
 & & \| & & & & \\
X_1 & \text{counts-as } Y_1 & \text{in } C_1 & & & &
\end{array}$$

c_1 is of type C_1, of type C_2 and of type C_3.

C_1, C_2 and C_3 are distinct from each other.

Channel theory enables us to talk not only about particular contexts such as c_1 but also about types of contexts such as C_1, C_2 and C_3.

Conditions on contexts

Channel theory enables us to talk not only about particular contexts such as c_1 but also about types of contexts such as C_1, C_2 and C_3.

If we are to be able to say under what conditions X counts as Y, we needs to be able to say, at least partly, what these types are.

This is one of the things we need to do in order to develop a logical analysis of social institutions in general and speech acts in particular.

A failed illocutionary act

A private: Clean this room.
A sergeant: You don't have the authority to give me a command.

Normally, privates would not say things like this to a sergeant. By contrast, the following looks normal.

A sergeant: Clean this room.
A privates: Yes, sir.

Judith's flashlight (Barwise and Seligman, 1997, p. 23)

In doing things in everyday life, we rely on various regularities that hold normally.

For example, by turning the switch of her flashlight on, Judith lights its bulb.

(1) The switch being on entails that the bulb is lit.

What will happen, however, if the battery is dead?

Weakening ? (Barwise & Seligman, p. 23)

By applying the inference rule called weakening, we could derive the following:

(2) The switch being on and the battery being dead entails that the bulb is lit.

Since this conclusion is unacceptable, we might wish to revise (1) and say:

(3) The switch being on and the battery being live entails that the bulb is lit.

What will happen, however, if the bulb is gone?

Background conditions and context shifts

The switch being on entails that the bulb is lit.

$\Downarrow$ The issue of whether the battery is alive or not is raised.

If the battery is live, the switch being on entails that the bulb is lit.

Classification (Barwise & Seligman, p. 69)

Definition. A *classification* $\mathbf{A} = \langle \mathrm{tok}(\mathbf{A}), \mathrm{typ}(\mathbf{A}), \models_{\mathbf{A}} \rangle$ consists of

1. a set, $\mathrm{tok}(\mathbf{A})$ of objects to be classified, called the *tokens* of $\mathbf{A}$,
2. a set, $\mathrm{typ}(\mathbf{A})$, of objects used to classify the tokens, called the *types* of $\mathbf{A}$, and
3. a binary relation, $\models_{\mathbf{A}}$, between tokens of $\mathbf{A}$ and types of $\mathbf{A}$.

If $a \models_{\mathbf{A}} \alpha$, then a is said to be *of type* α *in* $\mathbf{A}$.

A classification is depicted by means of a diagram as follows.

$$\begin{array}{c} \mathrm{typ}(\mathbf{A}) \\ \Big| \models_{\mathbf{A}} \\ \mathrm{tok}(\mathbf{A}) \end{array}$$

Sequents, constraints, the complete theory (Barwise & Seligman, p. 29)

By a *sequent* we just mean a pair $\langle \Gamma, \Delta \rangle$ of sets of types.

Definition. Let $\mathbf{A}$ be a classification and let $\langle \Gamma, \Delta \rangle$ be a sequent of $\mathbf{A}$.

- A token a of $\mathbf{A}$ satisfies $\langle \Gamma, \Delta \rangle$ provided that if a is of type α for every $\alpha \in \Gamma$ then a is of type β for some $\beta \in \Delta$.
- We say that Γ *entails* Δ in $\mathbf{A}$, written $\Gamma \vdash_{\mathbf{A}} \Delta$, if every token a of $\mathbf{A}$ satisfies $\langle \Gamma, \Delta \rangle$.
- If $\Gamma \vdash_{\mathbf{A}} \Delta$ then the pair $\langle \Gamma, \Delta \rangle$ is called a *constraint* supported by the classification $\mathbf{A}$.

Infomorphisms (Barwise & Seligman, p. 32)

Definition. If $\mathbf{A} = \langle \mathrm{tok}(\mathbf{A}), \mathrm{typ}(\mathbf{A}), \models_{\mathbf{A}} \rangle$ and $\mathbf{B} = \langle \mathrm{tok}(\mathbf{B}), \mathrm{typ}(\mathbf{B}), \models_{\mathbf{B}} \rangle$ are classifications, then an *infomorphism* is a pair $f = \langle f^{\wedge}, f^{\vee} \rangle$ of functions

$$\begin{tikzcd} \mathrm{typ}(\mathbf{A}) \arrow[r, "f^{\wedge}"] \arrow[d, dash, "\models_{\mathbf{A}}"] & \mathrm{typ}(\mathbf{B}) \arrow[d, dash, "\models_{\mathbf{B}}"] \\ \mathrm{tok}(\mathbf{A}) & \mathrm{tok}(\mathbf{B}) \arrow[l, "f^{\vee}"] \end{tikzcd}$$

satisfying the biconditional:

$$f^{\vee}(b) \models_{\mathbf{A}} \alpha \quad \text{iff} \quad b \models_{\mathbf{B}} f^{\wedge}(\alpha)$$

for all tokens b of $\mathbf{B}$ and all types α of $\mathbf{A}$.

Information Channels(Barwise & Seligman, pp. 34–35)

We say that $f = \langle f^{\wedge}, f^{\vee} \rangle$ is a contravariant pair from $\mathbf{A}$ to $\mathbf{B}$, and write $f : \mathbf{A} \rightleftarrows \mathbf{B}$, if $f^{\wedge} : \mathrm{typ}(\mathbf{A}) \to \mathrm{typ}(\mathbf{B})$ and $f^{\vee} : \mathrm{tok}(\mathbf{B}) \to \mathrm{tok}(\mathbf{A})$.

We think of an infomorphism $f = \langle f^{\wedge}, f^{\vee} \rangle$ as an infomorphism from $\mathbf{A}$ to $\mathbf{B}$ if it is a contravariant pair form $\mathbf{A}$ to $\mathbf{B}$.

Definition. An *information channel* consists of an indexed family $\mathcal{C} = \{f_i : A_i \rightleftarrows C\}$ of infomorphisms with a common codomain C called the *core* of the channel.

An example.

$\{f^\wedge_{Switch}(ON)\} \vdash_{\text{Flashlight}} \{f^\wedge_{Bulb}(LIT)\}$.

$$\begin{tikzcd} & \text{Flashlight} & \\ \text{Bulb} \arrow[ur, "f_{Bulb}"] & & \text{Switch} \arrow[ul, "f_{Switch}"'] \end{tikzcd}$$

$f^\vee_{Bulb}(f_t) \models_{Bulb}$ LIT $\qquad f^\vee_{Switch}(f_t) \models_{Switch}$ ON

A refinement (Barwise & Seligman, pp. 43–44)

Even if $\{f^\wedge_S(\text{ON})\} \vdash_F \{f^\wedge_B(\text{LIT})\}$ holds,

$$\begin{tikzcd} & \text{F} & \\ & \text{F}' \arrow[u, "r"] & \\ \text{B} \arrow[uur, "f_B"] \arrow[ur, "f'_B"'] & & \text{S} \arrow[uul, "f_S"'] \arrow[ul, "f'_S"] \end{tikzcd}$$

$\{f'^\wedge_S(\text{ON})\} \vdash_{F'} \{f'^\wedge_B(\text{LIT})\}$ might not hold.

Local logic (Barwise & Seligman, p. 40)

Definition. A *local logic* $\mathfrak{L} = \langle \text{A}, \vdash_{\mathfrak{L}}, N_{\mathfrak{L}} \rangle$ consists of

- a classification A,
- a set $\vdash_{\mathfrak{L}}$ of sequents (satisfying certain structural rules) involving the types of A, called the *constraints* of $\mathfrak{L}$, and
- a subset $N_{\mathfrak{L}}$ of the set of all the tokens of A, called the *normal tokens* of $\mathfrak{L}$, which satisfy all the constraints of $\vdash_{\mathfrak{L}}$.

A local logic $\mathfrak{L}$ is *sound* if every token is normal; it is *complete* if every sequent that holds of all normal tokens is in the consequence relation $\vdash_{\mathfrak{L}}$.

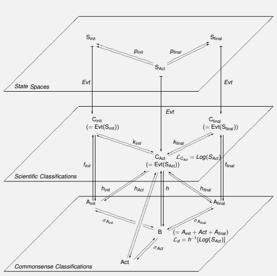
Idealization

Given a *local logic* $\mathfrak{L} = \langle \text{A}, \vdash_{\mathfrak{L}}, N_{\mathfrak{L}} \rangle$ on a classification A, we build the idealization infomorphism I as follows:

$$\begin{tikzcd} \mathrm{typ}(\text{A}) \arrow[r, "I^\wedge"] \arrow[d, dash, "\models_{\text{A}}"] & \mathrm{typ}(\text{A}^I) \arrow[d, dash, "\models_{\text{A}^I}"] \\ \mathrm{tok}(\text{A}) & \mathrm{tok}(\text{A}^I) \arrow[l, "I^\vee"] \end{tikzcd}$$

where $\mathrm{typ}(\text{A}^I) = \mathrm{typ}(\text{A})$, $\mathrm{tok}(\text{A}^I) = N_{\mathfrak{L}}$, and $\models_{\text{A}^I} = \ (\models_{\text{A}} \cap (N_{\mathfrak{L}} \times \mathrm{typ}(\text{A}^I)))$ with $I^\wedge(\alpha) = \alpha$ for any $\alpha \in \mathrm{typ}(\text{A})$ and $I^\vee(a) = a$ for any $a \in \mathrm{tok}(\text{A}^I)$. Then the local logic $\mathfrak{L}^I = \langle \text{A}^I, \vdash_{\mathfrak{L}}, N_{\mathfrak{L}} \rangle$ will be a sound local logic on A^I.

The Outline of a Dynamic Theory of Action (Barwise & Seligman, pp. 50-65)



Actions in channel theory

Actions are modeled as connections that connects initial states and final states of actions by constructing an information channel $\mathcal{C}_{Act} = \{f_{init} : \text{C}_{init} \rightleftarrows \text{C}_{Act},\ f_{fin} : \text{C}_{fin} \rightleftarrows \text{C}_{Act}\}$ such that C_{Act} classifies action tokens, and C_{init} and C_{fin} classify their initial states and final states respectively.

$$\begin{tikzcd} & \text{C}_{Act} & \\ \text{C}_{init} \arrow[ur, "f_{init}"] & & \text{C}_{fin} \arrow[ul, "f_{fin}"'] \end{tikzcd}$$

Then, the local logic on C_{Act} can be defined.

Acts of using flashlights in channel theory

Flashlight using actions are modeled as connections that connects initial states and final states of such actions by constructing an information channel $\mathcal{F}_{Act} = \{f_{init} : \text{F}_{init} \rightleftarrows \text{F}_{Act},\ f_{fin} : \text{F}_{fin} \rightleftarrows \text{F}_{Act}\}$ such that F_{Act} classifies flashlight using action tokens, and F_{init} and F_{fin} classify their initial states and final states respectively. Thus two copies of the earlier classification Flashlight can be used as F_{init} and F_{fin}.

$$\begin{tikzcd} & \text{F}_{Act} & \\ \text{F}_{init} \arrow[ur, "f_{init}"] & & \text{F}_{fin} \arrow[ul, "f_{fin}"'] \end{tikzcd}$$

Then, the local logic on F_{Act} can be defined.

Non-normal action tokens in the flashlight example

Even if $\langle \{f^\wedge_{init}(f^\wedge_{Switch}(\text{OFF})), \text{PSO}\}, \{f^\wedge_{fin}(f^\wedge_{Bulb}((\text{LIT})))\} \rangle$ holds,

$$\begin{tikzcd} & \text{F}_{Act} & \\ & \text{F}'_{Act} \arrow[u, "r"] & \\ \text{F}_{init} \arrow[uur, "f_{\text{init}}"] \arrow[ur, "f'_{\text{init}}"'] & & \text{F}_{fin} \arrow[uul, "f_{\text{fin}}"'] \arrow[ul, "f'_{\text{fin}}"] \end{tikzcd}$$

$\langle \{f'^\wedge_{init}(f^\wedge_{Switch}(\text{OFF}), \text{PSO}\}, \{f'^\wedge_{fin}(f^\wedge_{Bulb}(\text{LIT}))\} \rangle$ might not hold.

1. The problem
2. Actions in channel theory (Barwise & Seligman 1997)
3. Logical dynamics of speech acts
4. Acts of commanding in channel theory

The development of PAL

$[\varphi!]K_i\psi$
Public Announcement Logic PAL

adding dynamic modalities ↑ ↓ rewriting along recursion 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)

The development of DMEDL$^+$ Yamada (2016)

$[\text{command}_{(i,j)}\varphi]\psi$, $[\text{promise}_{(i,j)}\varphi]\psi$, $[\text{request}_{(i,j)}\varphi]\psi$, $[\text{assert}_{(i,j)}\varphi]\psi$
DMEDL$^+$ (Dynamified MEDL$^+$)

adding dynamic modalities ↑ ↓ rewriting along recursion axioms

MEDL (Multi-agent Epistemic Deontic Logic)
$K_i\varphi$, $O_{(i,j,k)}\varphi$

Dynamified Logics of acts of commanding and promising (Yamada, 2007a, b, 2008a, b)

$[com_{(i,j)}\varphi]\psi$, $[prom_{(i,j)}\varphi]\psi$
DMDL$^+$III (Dynamified Multi-agent Deontic Logic)

adding dynamic modalities ↑ ↓ rewriting along recursion axioms

MDL$^+$III (Multi-agent Deontic Logic)
$O_{(i,j,k)}\varphi$

The Language of MDL$^+$III and DMDL$^+$III

- $O_{(i,j,k)}\varphi$ It is obligatory for i with respect to j by the name of k to see to it that φ.
- i The agent who owes the obligation (obligor)
- j The agent to whom the obligation is owed (obligee)
- k The agent who creates the obligation
- $[com_{(i,j)}\varphi]\psi$ Whenever an agent i commands an agent j to see to it that φ, ψ holds in the resulting situation.
- $[prom_{(i,j)}\varphi]\psi$ Whenever an agent i promises an agent j that i will see to it that φ, ψ holds in the resulting situation.

More formally

Take a countably infinite set Aprop of proposition letters and a finite set I of agents, with p ranging over Aprop and i, j, k over I. The languages of MDL$^+$III and DMDL$^+$III are given respectively by:

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

$$\begin{array}{lcl} \varphi & ::= & \top \mid p \mid \neg\varphi \mid (\varphi \wedge \psi) \mid \Box\varphi \mid O_{(i,j,k)}\varphi \mid [\pi]\varphi \\ \pi & ::= & Com_{(i,j)}\varphi \mid Prom_{(i,j)}\varphi \end{array}$$

An $\mathcal{L}_{\mathrm{MDL^+III}}$-model

By an $\mathcal{L}_{\mathrm{MDL^+III}}$-model, we mean a quadruple $\mathcal{M} = \langle W^{\mathcal{M}}, A^{\mathcal{M}}, \{D^{\mathcal{M}}_{(i,j,k)} \mid i,j,k \in I\}, V^{\mathcal{M}}\rangle$ where:

1. $W^{\mathcal{M}}$ is a non-empty set (heuristically, of 'possible worlds'),
2. $A^{\mathcal{M}} \subseteq W^{\mathcal{M}} \times W^{\mathcal{M}}$,
3. $\{D^{\mathcal{M}}_{(i,j,k)} \mid i,j,k \in I\} \subseteq A^{\mathcal{M}}$,
4. $V^{\mathcal{M}}$ is a function that assigns a subset $V^{\mathcal{M}}(p)$ of $W^{\mathcal{M}}$ to each proposition letter $p \in$ **Aprop**.

Updating models

An acts of commanding

$\mathcal{M}, w \models_{\mathrm{DMDL^+III}} [Com_{(i,j)}\varphi]\psi$ iff $\mathcal{M}_{Com_{(i,j)}\varphi}, w \models_{\mathrm{DMDL^+III}} \psi$,

where $\mathcal{M}_{\mathrm{Com}_{(i,j)}\varphi}$ is the $\mathcal{L}_{\mathrm{MDL^+III}}$-model obtained from $\mathcal{M}$ by replacing $D_{(j,i,i)}$ with $\{(x,y) \in D_{(j,i,i)} \mid \mathcal{M}, y \models_{\mathrm{DMDL^+III}} \varphi\}$.

An acts of promising

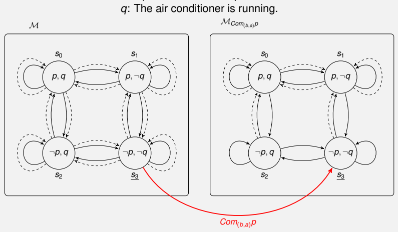
$\mathcal{M}, w \models_{\mathrm{DMDL^+III}} [Prom_{(i,j)}\varphi]\psi$ iff $\mathcal{M}_{Prom_{(i,j)}\varphi}, w \models_{\mathrm{DMDL^+III}} \psi$,

where $\mathcal{M}_{\mathrm{Prom}_{(i,j)}\varphi}$ is the $\mathcal{L}_{\mathrm{MDL^+III}}$-model obtained from $\mathcal{M}$ by replacing $D_{(i,j,i)}$ with $\{(x,y) \in D_{(i,j,i)} \mid \mathcal{M}, y \models_{\mathrm{DMDL^+III}} \varphi\}$.

Your boss's act of commanding

$$\mathcal{M}, w \models_{\mathrm{DMDL^+III}} [Com_{(i,j)}\varphi]\psi \text{ iff } \mathcal{M}_{Com_{(i,j)\varphi}}, w \models_{\mathrm{DMDL^+III}} \psi.$$

p: The window is open.
q: The air conditioner is running.



$\mathcal{M}, s_3 \models_{\mathrm{DMDL^+III}} \neg O_{(a,b,b)}p$. $\quad \mathcal{M}_{Com_{(b,a)}p}, s_3 \models_{\mathrm{DMDL^+III}} O_{(a,b,b)}p$

Acts of Commanding and Acts of Promising

The CUGO Principle

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

$$[Com_{(i,j)}\varphi]O_{(j,i,i)}\varphi$$

The PUGO Principle

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

$$[Prom_{(i,j)}\varphi]O_{(i,j,i)}\varphi$$

A command and a promise can lead to a dilemma

A contingent dilemma

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

p You will attend the conference in São Paulo on 11 July 2020.
q You will join the demonstration in Sapporo on 11 July 2020.

Acts of commanding in channel theory

In order to address issues raised at the beginning of this talk, we construct an information channel from the language and the models of DMDL$^+$III.

$$\begin{tikzcd} & \mathrm{D}^{\mathcal{M}}_{Act} & \\ \mathrm{D}^{\mathcal{M}}_{init} \arrow[ur, "f_{init}"] & & \mathrm{D}^{\mathcal{M}}_{fin} \arrow[ul, "f_{fin}"'] \end{tikzcd}$$

How to do that

- For the sake of simplicity, we ignore acts of promising and alethic modality. Thus, we will work with a fragment of $\mathfrak{L}_{\mathrm{DMDL^+III}}$ which lacks the promise modalities and the alethic modality. Call it the command fragment of $\mathfrak{L}_{\mathrm{DMDL^+III}}$.
- We will work not with the whole class of $\mathfrak{L}_{\mathrm{DMDL^+III}}$-models but with a set of $\mathfrak{L}_{\mathrm{DMDL^+III}}$-models obtained by updating an arbitrary chosen one.

Deontic state classification 1/2

Given the command fragment of the language $\mathfrak{L}_{\mathrm{DMDL^+III}}$ of DMDL$^+$III, an arbitrary model $\mathcal{M}$ of the static base logic MDL$^+$III, and the truth-in relation $\models_{\mathrm{DMDL^+III}}$, the classification $\mathrm{D}^{\mathcal{M}} = \langle \mathrm{tok}(\mathrm{D}^{\mathcal{M}}), \mathrm{typ}(\mathrm{D}^{\mathcal{M}}), \models_{\mathrm{D}^{\mathcal{M}}} \rangle$ is defined as follows:

$$\begin{array}{c} \mathrm{typ}(\mathrm{D}^{\mathcal{M}}) \\ \Big| \models^{\mathcal{M}}_{\mathrm{D}} \\ \mathrm{tok}(\mathrm{D}^{\mathcal{M}}) \end{array}$$

Deontic state classification 2/2

$$\begin{array}{c} \mathrm{typ}(\mathrm{D}^{\mathcal{M}}) \\ \Big| \models^{\mathcal{M}}_{\mathrm{D}} \\ \mathrm{tok}(\mathrm{D}^{\mathcal{M}}) \end{array}$$

1. Let σ be a possibly empty finite sequence $\pi_0, \pi_1, \ldots, \pi_n$ of action types from the language $\mathfrak{L}_{\mathrm{DMDL^+III}}$ each of which is of form $Com_{(i,j)}\varphi$, and $\mathcal{M}_\sigma = (\ldots((\mathcal{M}_{\pi_0})_{\pi_1} \ldots)_{\pi_n}$.
2. $\mathrm{tok}(\mathrm{D}^{\mathcal{M}})$ is a set of model world pairs of form $\langle \mathcal{M}_\sigma, w \rangle$,
3. $\mathrm{typ}(\mathrm{D}^{\mathcal{M}})$ is the set of the formulas of the command fragment of $\mathfrak{L}_{\mathrm{DMDL^+III}}$, and
4. $\langle \mathcal{M}_\sigma, w \rangle \models_{\mathrm{D}^{\mathcal{M}}} \varphi$ iff $\mathcal{M}_\sigma, w \models_{\mathrm{DMDL^+III}} \varphi$.

This classification can be used both as the initial state classification $\mathrm{D}^{\mathcal{M}}_{init}$ and as the final state classification $\mathrm{D}^{\mathcal{M}}_{fin}$.

Command channel 1/3

Then an information channel $\mathcal{D}^{\mathcal{M}} = \{f_{init} : \mathrm{D}^{\mathcal{M}}_{init} \rightleftarrows \mathrm{D}^{\mathcal{M}}_{Act},\ f_{fin} : \mathrm{D}^{\mathcal{M}}_{fin} \rightleftarrows \mathrm{D}^{\mathcal{M}}_{Act}\}$ with a core $\mathrm{D}^{\mathcal{M}}_{Act}$ can be defined as follows:

$$\begin{tikzcd} & \mathrm{D}^{\mathcal{M}}_{Act} & \\ \mathrm{D}^{\mathcal{M}}_{init} \arrow[ur, "f_{init}"] & & \mathrm{D}^{\mathcal{M}}_{fin} \arrow[ul, "f_{fin}"'] \end{tikzcd}$$

1. Action tokens of $\mathrm{D}^{\mathcal{M}}_{Act}$ can be modeled as connections of the form $\langle s_1, s_2\rangle$ such that s_1 is a token of $\mathrm{D}^{\mathcal{M}}_{init}$, s_2 is a token of $\mathrm{D}^{\mathcal{M}}_{fin}$, and for some sequence σ of action types and an action type $\mathrm{com}_{(i,j)}\varphi$, $s_1 = \langle \mathcal{M}_\sigma, w\rangle$ and $s_2 = \langle (\mathcal{M}_\sigma)_{\mathrm{com}_{(i,j)}\varphi}, w\rangle$. This gives us the set $\mathrm{tok}(\mathrm{D}^{\mathcal{M}})$ of the tokens of $\mathrm{D}^{\mathcal{M}}_{Act}$.

Command channel 2/3

$$\begin{tikzcd} & \mathrm{D}^{\mathcal{M}}_{Act} & \\ \mathrm{D}^{\mathcal{M}}_{init} \arrow[ur, "f_{init}"] & & \mathrm{D}^{\mathcal{M}}_{fin} \arrow[ul, "f_{fin}"'] \end{tikzcd}$$

2. Set of types $\mathrm{typ}(\mathrm{D}^{\mathcal{M}}_{Act})$ of the classification $\mathrm{D}^{\mathcal{M}}_{Act}$ consists of action types of the language $\mathfrak{L}_{\mathrm{DMDL^+III}}$ and translations $f^{\wedge}_{init}(\varphi)$ and $f^{\wedge}_{fin}(\varphi)$ of each formula φ of $\mathfrak{L}_{\mathrm{DMDL^+III}}$ given by $f^{\wedge}_{init}$ and $f^{\wedge}_{fin}$ respectively.
3. For tokens, $f^{\vee}_{init}(\langle s_1, s_2\rangle) = s_1$ and $f^{\vee}_{fin}(\langle s_1, s_2\rangle) = s_2$.

Command channel 3/3

$$\begin{tikzcd} & \mathrm{D}^{\mathcal{M}}_{Act} & \\ \mathrm{D}^{\mathcal{M}}_{init} \arrow[ur, "f_{init}"] & & \mathrm{D}^{\mathcal{M}}_{fin} \arrow[ul, "f_{fin}"'] \end{tikzcd}$$

4. The classification relation $\models_{\mathrm{D}^{\mathcal{M}}_{Act}}$ is defined by the following three conditions:
   1. $\langle s_1, s_2\rangle \models_{\mathrm{D}^{\mathcal{M}}_{Act}} f^{\wedge}_{init}(\varphi)$ iff $f^{\vee}_{init}(\langle s_1, s_2\rangle) \models_{\mathrm{D}^{\mathcal{M}}_{init}} \varphi$,
   2. $\langle s_1, s_2\rangle \models_{\mathrm{D}^{\mathcal{M}}_{Act}} f^{\wedge}_{fin}(\varphi)$ iff $f^{\vee}_{fin}(\langle s_1, s_2\rangle) \models_{\mathrm{D}^{\mathcal{M}}_{fin}} \varphi$,
   3. $\langle s_1, s_2\rangle \models_{\mathrm{D}^{\mathcal{M}}_{Act}} Com_{(i,j)}\varphi$ iff for some sequence σ of action types and a world w, $s_1 = \langle \mathcal{M}_\sigma, w\rangle$, $s_2 = \langle (\mathcal{M}_\sigma)_{Com_{(i,j)}\varphi}, w\rangle$.
5. Then the pairs $f_{init} = \langle f^{\wedge}_{init}, f^{\vee}_{init}\rangle$ and $f_{fin} = \langle f^{\wedge}_{fin}, f^{\vee}_{fin}\rangle$ are infomorphisms, and thus we get the desired information channel $\mathcal{D}^{\mathcal{M}}$.

We will omit the superscript "$^{\mathcal{M}}$" hereafter.

Local logic on D_{Act}

Now we can define a local logic $\mathfrak{L}_{\mathrm{D}_{Act}} = \langle \mathrm{D}_{Act}, \vdash_{\mathfrak{L}_{\mathrm{D}_{Act}}}, N_{\mathfrak{L}_{\mathrm{D}_{Act}}}\rangle$ on D_{Act}.

$$\begin{tikzcd} & \mathrm{D}_{Act} & \\ \mathrm{D}_{init} \arrow[ur, "f_{init}"] & & \mathrm{D}_{fin} \arrow[ul, "f_{fin}"'] \end{tikzcd}$$

Constraints of $\mathfrak{L}_{\mathrm{D}_{Act}}$

Constraints in $\vdash_{\mathfrak{L}_{\mathrm{D}_{Act}}}$ can be derived from the valid formulas of DMDL$^+$III. For example:
As we have

$$\models_{\mathrm{DMDL^+III}} [Com_{(i,j)}\varphi](\psi \wedge \xi) \rightarrow [Com_{(i,j)}\varphi]\psi \quad .$$

we have

$$\{\, f^{\wedge}_{init}([Com_{(i,j)}\varphi](\psi \wedge \xi)) \,\} \vdash_{\mathcal{L}_{\mathrm{D}_{Act}}} \{\, f^{\wedge}_{init}([Com_{(i,j)}\varphi]\psi) \,\}$$
$$\{\, f^{\wedge}_{fin}([Com_{(i,j)}\varphi](\psi \wedge \xi)) \,\} \vdash_{\mathcal{L}_{\mathrm{D}_{Act}}} \{\, f^{\wedge}_{fin}([Com_{(i,j)}\varphi]\psi) \,\} \quad .$$

Constraints of $\mathfrak{L}_{\mathrm{D}_{Act}}$ (2/2)

More generally, for any φ such that $\models_{\mathrm{DMDL^+III}} \varphi$, we have

$$\emptyset \vdash_{\mathcal{L}_{\mathrm{D}_{Act}}} \{\, f^{\wedge}_{init}(\varphi) \,\}$$
$$\emptyset \vdash_{\mathcal{L}_{\mathrm{D}_{Act}}} \{\, f^{\wedge}_{fin}(\varphi) \,\} \quad .$$

More interestingly, we have

$$\{\, f^{\wedge}_{init}([Com_{(i,j)}\varphi]\psi), Com_{(i,j)}\varphi \,\} \vdash_{\mathcal{L}_{\mathrm{D}_{Act}}} \{\, f^{\wedge}_{fin}(\psi) \,\}$$
$$\{\, f^{\wedge}_{fin}(\psi), Com_{(i,j)}\varphi \,\} \vdash_{\mathcal{L}_{\mathrm{D}_{Act}}} \{\, f^{\wedge}_{init}([Com_{(i,j)}\varphi]\psi) \,\} \quad .$$

How about CUGO Principle ?

The CUGO Principle

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

$$[Com_{(i,j)}\varphi]O_{(j,i,i)}\varphi$$

If we wish to have a sound local logic, we have to accept

$$\emptyset \not\vdash_{\mathcal{L}_{\mathrm{D}_{Act}}} \{\, f^{\wedge}_{init}([Com_{(i,j)}\varphi]O_{(j,i,i)}\varphi) \,\}$$
$$\emptyset \not\vdash_{\mathcal{L}_{\mathrm{D}_{Act}}} \{\, f^{\wedge}_{fin}([Com_{(i,j)}\varphi]O_{(j,i,i)}\varphi) \,\} \quad .$$

The problem of how we could characterize the class of formulas φ such that $[Com_{(i,j)}\varphi]O_{(j,i,i)}\varphi$ is valid is still open.

How about CUGO Principle ? (2)

Let us say φ is non-deontic if $\varphi \in \mathcal{L}_{\mathrm{MDL^+III}}$ and no deontic modality occurs in φ.

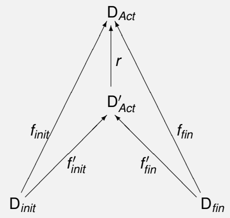
If we model a community where people only issue commands with non-deontic contents, CUGO-principle will be valid.

If we model such a community by $\mathcal{D}^-$, we will have

$$\emptyset \vdash_{\mathcal{L}_{\mathrm{D}^-_{Act}}} \{\, f^{\wedge}_{init}([Com_{(i,j)}\varphi]O_{(j,i,i)}\varphi) \,\}$$
$$\emptyset \vdash_{\mathcal{L}_{\mathrm{D}^-_{Act}}} \{\, f^{\wedge}_{fin}([Com_{(i,j)}\varphi]O_{(j,i,i)}\varphi) \,\} \quad .$$

Refinement/Idealization

If we only include constraints derived from valid formulas of DMDL^{+}III, both $\mathfrak{L}_{\mathrm{D}_{Act}}$ and $\mathfrak{L}_{\mathrm{D}'_{Act}}$ will be sound.



How then is D'_{Act} different from D_{Act}?

A failed illocutionary act again

A private: Clean this room.

A sergeant: You don't have the authority to give me a command.

Normally, privates would not say things like this to a sergeant. By contrast, the following looks normal.

A sergeant: Clean this room.

A privates: Yes, sir.

Condition of authority

In the flashlight example, the background condition that the battery is live is the condition that must be satisfied in order for an act of pushing the switch into the on position to be a way of turning the flashlight on.

Similarly, the condition that the agent has the suitable authority to issue such and such a command is the condition that must be satisfied in order for her act of saying so and so counts as an act of commanding.

Authority

The language of DMDL^{+}III has to be substantially extended if we are to talk about such background conditions. This is partly done in Yamada (2015).

Let org_h indexed by a finite set of organizations H be a function that assigns a possibly empty subset of the set of command types $\mathrm{org}_h(i,j,w)$ to each pair of agents $\langle i,j\rangle \in I \times I$ for each world w. Thus, $\mathrm{org}_h(i,j,w)$ is a set of command types an organization h authorizes i to give j in w. Then we define

$$\mathcal{M}, w \models_{\mathrm{DMDL^{+}III^{*}}} \mathrm{Auth}_{(i,j,h)}\varphi \text{ iff } \mathrm{com}_{(i,j)}\varphi \in \mathrm{org}_h(i,j,w) \quad .$$

Acts of saying

The language of DMDL^{+}III has to be substantially extended in other respect as well, if we are to capture the kind of regularities included in normal situations. We have to be able to talk about acts of saying so and so (locutionary acts).

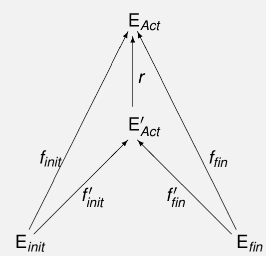
Let CTR be the type of acts of saying "Clean this room" while pointing to a particular room r, and p be the proposition that r is clean .

Then, roughly speaking, the relevant regularity will be of the form $\langle\{Say_{(i,j)}\mathrm{CTR}\}, \{Com_{(i,j)}p\}\rangle$.

This is a channel theoretic analogue of count-as conditional.

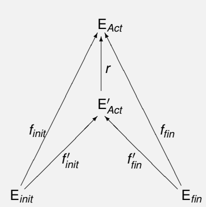
An enriched classification

An act of type $Say_{(i,j)}\mathrm{CTR}$ counts-as an act of type $Com_{(i,j)}p$ in a context of type $\mathrm{Auth}_{(i,j,h)}\varphi$ for some h.



Count-as conditionals

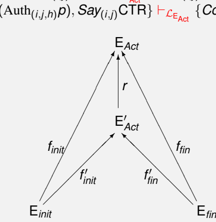
$\{Say_{(i,j)}\mathrm{CTR}\} \vdash_{\mathcal{L}_{\mathrm{E}_{Act}}} \{Com_{(i,j)}p\}$



$\{Say_{(i,j)}\mathrm{CTR}\} \nvdash_{\mathcal{L}_{\mathrm{E}'_{Act}}} \{Com_{(i,j)}p\}$

Context types

$\{Say_{(i,j)}\mathrm{CTR}\} \vdash_{\mathcal{L}_{\mathrm{E}_{Act}}} \{Com_{(i,j)}p\}$
$\{f^{\wedge}_{init}(\mathrm{Auth}_{(i,j,h)}p), Say_{(i,j)}\mathrm{CTR}\} \vdash_{\mathcal{L}_{\mathrm{E}_{Act}}} \{Com_{(i,j)}p\}$



$\{Say_{(i,j)}\mathrm{CTR}\} \nvdash_{\mathcal{L}_{\mathrm{E}'_{Act}}} \{Com_{(i,j)}p\}$
$\{f'^{\wedge}_{init}(\mathrm{Auth}_{(i,j,h)}p), Say_{(i,j)}\mathrm{CTR}\} \vdash_{\mathcal{L}_{\mathrm{E}'_{Act}}} \{Com_{(i,j)}p\}$

Count-as conditionals and CUGO Principle

A sergeant a said "Clean this room", addressing a private b and pointing to the room r.

$\Downarrow$ [count-as] $\{Say_{(a,b)}\mathrm{CTR}\} \vdash_{\mathcal{L}_{\mathrm{E}_{Act}}} \{Com_{(a,b)}p\}$

a commanded b to see to it that r is clean.

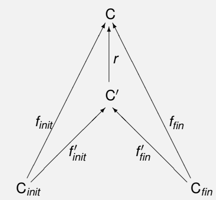
$\Downarrow$ [CUGO] $\{\, Com_{(a,b)}p \,\} \vdash_{\mathcal{L}_{\mathrm{E}_{Act}}} \{\, f^{\wedge}_{fin}(O_{(b,a,a)}p) \,\}$

b is obligated to see to it that r is clean with respect to a by the name of a.

X counts as Y in context C

Let C^* be the set of conditions that characterize C relative to C'.

$\{X\} \vdash_{\mathcal{L}_C} \{Y\}$

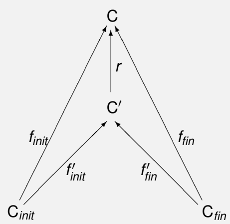


$\{X\} \nvdash_{\mathcal{L}_{C'}} \{Y\}$

$\{f'^{\wedge}_{init}(C^*), X\} \vdash_{\mathcal{L}_{C'}} \{Y\}$

Count-as conditionals and the Dynamic Logic of Y-ing

$\{X\} \vdash_{\mathcal{L}_C} \{Y\}$, $\{f^{\wedge}_{init}([Y]\varphi), Y\} \vdash_{\mathcal{L}_C} \{f^{\wedge}_{fin}(\varphi)\}$



$\{X\} \nvdash_{\mathcal{L}_{C'}} \{Y\}$, $\{f'^{\wedge}_{init}(C^*), X\} \vdash_{\mathcal{L}_{C'}} \{Y\}$

What about C^*?

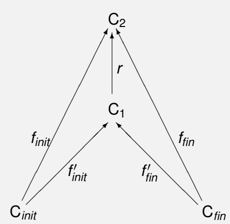
Things can go wrong in so many different ways.

Theorizing usually calls for context-shifts.

Theorizing might still be situated after such context shifts in the sense that the regularity a theorist asserts might depend on yet to be known further background conditions.

What about the hierarchy?

$\{X_2\} \vdash_{\mathcal{L}_{C_2}} \{Y_2\}$, $\{f^{\wedge}_{init}([Y_2]\varphi), Y_2\} \vdash_{\mathcal{L}_{C_2}} \{f^{\wedge}_{fin}(\varphi)\}$



$\{X_1\} \vdash_{\mathcal{L}_{C_1}} \{Y_1\}$, $Y_1 = X_2$, $\{X_2\} \nvdash_{\mathcal{L}_{C_1}} \{Y_2\}$, $\{f'^{\wedge}_{init}(C^*), X_2\} \vdash_{\mathcal{L}_{C_1}} \{Y_2\}$

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The End

Thanks!!