LOGICS OF AGENCY

CHAPTER 4: APPLICATIONS OF AGENCY TO SOCIAL INFLUENCE AND OBLIGATIONS

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OVERVIEW OF THIS CHAPTER

- Social influence
- Horty's obligation to do

More theses from [Belnap et al. 2001]

Definition (Imperative content thesis)

Regardless of its force on an occasion of use, the content of every imperative is agentive.

Definition (Restricted complement thesis)

A variety of constructions concerned with agents and agency—including deontic statements, imperatives, and statements of intentions, among others—must take agentives as their complements.

Definition (Stit normal form thesis)

In investigations of those constructions that take agentives as complements, nothing but confusion is lost if the complements are taken to be all and only stit sentences.

Obligations to do

$$O_{John} \triangledown_{John} \text{“dinner is ready”}$$

Delegations / Imperatives:

$$\triangledown_{Mary} O_{John} \triangledown_{John} \text{“dinner is ready”}$$

Constraining a behaviour:

$$\triangledown_{Mary} \triangledown_{John} \text{“dinner is ready”}$$

Deliberate inaction:

$$\triangledown_{Mary} \neg \triangledown_{Mary} \text{“Mary eats chocolate”}$$

OUTLINE

A common theme: [Chellas 1969], [Santos et al. 1996, 1997], [Norman & Reed 2010]...

Neighbourhoods semantics of individual bringing-it-about (reminder)

$M = \langle W, EE, EC, V \rangle$

- W is some set of possible worlds,
- $V : \text{Prop} \longrightarrow \mathcal{P}(W)$ is a valuation function
- $EE : W \times \text{Agt} \longrightarrow \mathcal{P}(\mathcal{P}(W))$
- $EC : W \times \text{Agt} \longrightarrow \mathcal{P}(\mathcal{P}(W))$

Constraints on the neighborhoud functions:

- $W \notin EE(w, i)$
- $\emptyset \notin EC(w, i)$
- if $X \in EE(w, i)$, then $w \in X$
- if $X \in EE(w, i)$ and $Y \in EE(w, i)$ then $X \cap Y \in EE(w, i)$
- $EE(w, i) \subseteq EC(w, i)$

Truth values:

$$\begin{array}{lll} M, w \models p & \text{iff} & w \in V(p); \\ M, w \models E_i\varphi & \text{iff} & ||\varphi||^M \in EE(w, i); \\ M, w \models C_i\varphi & \text{iff} & ||\varphi||^M \in EC(w, i). \end{array}$$

Neighbourhoods semantics of coalitional bringing-it-about

$M = \langle W, EE, EC, V \rangle$

- W is some set of possible worlds,
- $V : \text{Prop} \longrightarrow \mathcal{P}(W)$ is a valuation function
- $EE : W \times \mathcal{P}(\text{Agt}) \longrightarrow \mathcal{P}(\mathcal{P}(W))$
- $EC : W \times \mathcal{P}(\text{Agt}) \longrightarrow \mathcal{P}(\mathcal{P}(W))$

Constraints on the neighborhoud functions:

- analogous to the individual case
- $EC(w, \emptyset) = \emptyset$
- $X \in EE(w, G_1)$ and $Y \in EE(w, G_2)$ then $X \cap Y \in EC(w, G_1 \cup G_2)$

Truth values:

$$
\begin{array}{lll}
M, w \models p & \text{iff} & w \in V(p); \\
M, w \models E_G\varphi & \text{iff} & ||\varphi||^M \in EE(w, G); \\
M, w \models C_G\varphi & \text{iff} & ||\varphi||^M \in EC(w, G).
\end{array}
$$

For all groups G, G_1, and G_2 and formulas φ and ψ:

- **[Ax0]** $\vdash \varphi$, when φ is a tautology in propositional logic
- **[Ax1]** $\vdash E_G\varphi \wedge E_G\psi \rightarrow E_G(\varphi \wedge \psi)$
- **[Ax2]** $\vdash E_G\varphi \rightarrow \varphi$
- **[Ax3]** $\vdash E_G\varphi \rightarrow C_G\varphi$
- **[Ax4]** $\vdash \neg C_G\bot$
- **[Ax5]** $\vdash \neg C_G\top$
- **[Ax6]** $\vdash \neg C_\emptyset\varphi$
- **[Ax7]** $\vdash E_{G_1}\varphi \wedge E_{G_2}\psi \rightarrow C_{G_1 \cup G_2}(\varphi \wedge \psi)$
- **[ERE]** if $\vdash \varphi \leftrightarrow \psi$ then $\vdash E_G\varphi \leftrightarrow E_G\psi$
- **[ERC]** if $\vdash \varphi \leftrightarrow \psi$ then $\vdash C_G\varphi \leftrightarrow C_G\psi$

Strict joint agency

- It seems right that if G_1 acting as a coalition is bringing about a goal φ, then all the members of G_1 are actually contributing in some way to φ. (e.g., [Lindahl 1977])
- They might be necessary for the performance of a bodily movement, or they might be necessary for the group attitude that is put into the goal X.
- We use the term team to capture this.
- The members of the team G_1, each with a group attitude towards the coalition G_1 with regard to φ, when $G_2 \subset G_1$ the group G_2 cannot be agentive for φ. At least the group G_2 is not bringing about the goal φ as a team.

$$[\mathbf{Ax8}] \ \vdash E_{G_1}\varphi \rightarrow \neg E_{G_2}\varphi, \text{ when } G_2 \subset G_1$$

- The contrapositive of the constraint is the notion of strict joint agency ([Belnap et al. 2001], [Carmo 2010]).

Making do / delegation ([Chellas 1969], and many others):

$$E_a E_b \varphi$$

$$E_a E_b \varphi \to E_a \varphi$$

$$[\mathbf{Ax9}] \vdash E_{G_1} E_{G_2} \varphi \to E_{G_1} \varphi$$

- [Chellas 1969]: "quid facit per alium facit per se". When agent *a* makes another agent bring about something, agent *a* is himself bringing about that something.
- Elgesem rejects the constraint: "a person is normally not considered the agent of some consequence of his action if another agent interferes in the causal chain." [Elgesem 1993, p. 82].
- [Santos et al. 1997] propose two notions of agency:
  - If agent *a* directly brings about that *b* directly brings about that φ then *a* does not directly bring about the φ.
  - But they adopt the principle for indirect actions.

1. $Ax8, Ax9 \vdash E_a\varphi \to \neg E_{\{a,b\}}\varphi$ (instance of axiom Ax8)
2. $Ax8, Ax9 \vdash E_aE_b\varphi \to E_a\varphi$ (instance of axiom Ax9)
3. $Ax8, Ax9 \vdash E_aE_b\varphi \to \neg E_{\{a,b\}}\varphi$ (from 1. and 2. by Propositional Logic)
4. $Ax8, Ax9 \vdash E_aE_b\varphi \to E_b\varphi$ (instance of axiom Ax2)
5. $Ax8, Ax9 \vdash E_aE_b\varphi \to E_a\varphi \wedge E_b\varphi$ (from 2. and 4. by PL)
6. $Ax8, Ax9 \vdash E_a\varphi \wedge E_b\varphi \to C_{\{a,b\}}\varphi$ (instance of axiom Ax7)
7. $Ax8, Ax9 \vdash E_aE_b\varphi \to \neg E_{\{a,b\}}\varphi \wedge C_{\{a,b\}}\varphi$ (from 3., 5. and 6. by PL)

Impossible intra-team commands (II)

1. $Ax8, Ax9 \vdash E_{\{a,b\}}E_b\varphi \rightarrow E_{\{a,b\}}\varphi$ (instance of axiom Ax9)
2. $Ax8, Ax9 \vdash E_{\{a,b\}}E_b\varphi \rightarrow E_b\varphi$ (instance of axiom Ax2)
3. $Ax8, Ax9 \vdash E_b\varphi \rightarrow \neg E_{\{a,b\}}\varphi$ (instance of axiom Ax8)
4. $Ax8, Ax9 \vdash E_{\{a,b\}}E_b\varphi \rightarrow E_{\{a,b\}}\varphi \wedge \neg E_{\{a,b\}}\varphi$ (from 1., 2., and 3. by PL)
5. $Ax8, Ax9 \vdash \neg E_{\{a,b\}}E_b\varphi$ (from 4. by PL)

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1. $Ax8, Ax9 \vdash E_bE_{\{a,b\}}\varphi \rightarrow E_{\{a,b\}}\varphi$ (instance of axiom Ax2)
2. $Ax8, Ax9 \vdash E_bE_{\{a,b\}}\varphi \rightarrow E_b\varphi$ (instance of axiom Ax9)
3. $Ax8, Ax9 \vdash E_b\varphi \rightarrow \neg E_{\{a,b\}}\varphi$ (instance of axiom Ax8)
4. $Ax8, Ax9 \vdash E_bE_{\{a,b\}}\varphi \rightarrow E_{\{a,b\}}\varphi \wedge \neg E_{\{a,b\}}\varphi$ (from 1., 2., and 3. by PL)
5. $Ax8, Ax9 \vdash \neg E_bE_{\{a,b\}}\varphi$ (from 4. by PL)

$$[\textbf{Ax10}]\ \vdash E_{G_1} E_{G_2}\varphi \rightarrow E_{G_1\cup G_2}\varphi$$

1. $Ax10 \vdash E_a E_b\varphi \rightarrow E_b\varphi$ (instance of axiom Ax2)
2. $Ax10 \vdash E_a E_b\varphi \rightarrow E_{\{a,b\}}\varphi$ (instance of axiom Ax10)
3. $Ax10 \vdash E_a E_b\varphi \rightarrow E_b\varphi \wedge E_{\{a,b\}}\varphi$ (from 1., and 2. by PL)

Funny interaction with strict joint agency (suppose $G_2 \neq \emptyset$):

1. $Ax10, Ax8 \vdash E_{G_1} E_{G_2}\varphi \rightarrow E_{G_1\cup G_2}\varphi$ (instance of axiom Ax10)
2. $Ax10, Ax8 \vdash E_{G_1} E_{G_2}\varphi \rightarrow E_{G_2}\varphi$ (instance of axiom Ax2)
3. $Ax10, Ax8 \vdash E_{G_2}\varphi \rightarrow \neg E_{G_1\cup G_2}\varphi$ (instance of axiom Ax8)
4. $Ax10, Ax8 \vdash \neg E_{G_1} E_{G_2}\varphi$ (from 1., 2., and 3. by PL)

Delegations: commands as imposing norms

General pattern:

$$E_a O E_b \varphi$$

Delegations within institutions
[Santos and Jones, Carmo and Pacheco, Sartor, ...]

- agency of an individual agent:

$$E_a \varphi \Rightarrow \text{“agent } a \text{ is agentive for } \varphi\text{”}$$

- agency of an agent in a role:

$$E_{a:r} \varphi \Rightarrow \text{“agent } a \text{ playing the role } r \text{ is (ex-post acto) responsible } \varphi\text{”}$$

- obligations of an agent in a role:

$$O E_{a:r} \varphi \Rightarrow \text{“agent } a \text{ playing the role } r \text{ ought to achieve } \varphi\text{”}$$

- institutional delegation:

$$E_{a:boss} O E_{b:emp} \varphi \Rightarrow \text{“Boss } a \text{ delegates } \varphi \text{ to employee } b\text{”}$$

Social influence in Hamblin's style logics

In [Norman & Reed 2010], actions, and doings. E.g.:

- $E_{Joe} \mathsf{T}_{Avrel} \alpha_{\text{shoot}}$
- $E_{Joe} E_{Avrel} \mathsf{T}_{Avrel} \alpha_{\text{strangle}}$.

"Making do" generally falls flat in STIT theories:

- Chellas' stit: John makes Ana do φ only if φ is settled (independence of agents)
- Achievement and deliberative stit: delegation is impossible (negative condition)
- It can be amended nicely in a deontic context (next section of these slides)

Refraining from doing φ:

$$[i\ \mathit{dstit} : \neg[i\ \mathit{dstit} : \varphi]]$$

REFREF principle [Belnap et al. 2001]:

$$[i\ \mathit{dstit} : \neg[i\ \mathit{dstit} : [i\ \mathit{dstit} : \neg[i\ \mathit{dstit} : \varphi]]]] \leftrightarrow [i\ \mathit{dstit} : \varphi]$$

REFREF does not work in astit in general.

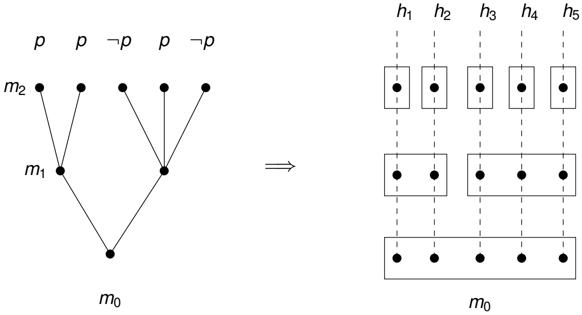
Outline

[HORTY 2001]

Horty's deontic logic for representing and reasoning about what agents ought to do (and ought to be the case).

BT STRUCTURES (REMINDER)

BT structure $\langle Mom, < \rangle$:



- History = maximally $<$-ordered set of moments
- *Hist* = set of all histories
- H_m = set of histories passing through the moment m
- Explode moments into indexes (moment/history pairs)
  - $m_0/h_3 \not\models \mathbf{F}p$
  - $m_0/h_1 \models \mathbf{F}p$

$BT + AC$ MODELS (REMINDER)

A $BT + AC$ model is a tuple $\mathcal{M} = \langle Mom, <, Choice, v\rangle$, where:

- $\langle Mom, <\rangle$ is a BT structure;
- $Choice : \text{Agt} \times Mom \to \mathcal{P}(\mathcal{P}(Hist))$;
  - $Choice : \text{Agt} \times Mom \to \mathcal{P}(\mathcal{P}(Hist))$
    - $Choice(a, m)$ = repertoire of choices for agent a at moment m
    - $Choice$ is a function mapping each agent and each moment m into a partition of H_m
  - $Choice(a, m) : Hist \to \mathcal{P}(Hist)$
    - For $h \in H_m$: $Choice(a, m)(h)$ = the particular choice of a at index m/h.
  - Independence of agents/choices: Let h, m.
    For all collections of $X_a \in Choice(a, m)(h)$, $\bigcap_{a \in Agt} X_a \neq \emptyset$.
  - No choice between undivided histories: if $\exists m' > m$ s.t. $h, h' \in H_{m'}$ then $h' \in Choice(a, m)(h)$.n
- v is valuation function $v : \text{Prop} \to \mathcal{P}(Mom \times Hist)$.

- "Chellas" stit:
  $M, m/h \models [G\, cstit: \varphi]$ iff $M, m/h' \models \varphi$ for all $h' \in Choice(G, m)(h)$
- historical necessity:
  $M, m/h \models \Box\varphi$ iff $M, m/h' \models \varphi$ for all $h' \in H_m$

Linear time modalities:

- **F** future
- **P** past

Standard deontic models [Horty 2001]

A standard deontic models is a tuple
$\mathcal{M} = \langle Mom, <, Choice, Ought, v \rangle$, where:

- $\langle Mom, <, Choice, v \rangle$ is a $BT + AC$ model;
- *Ought* maps each moment $m \in Mom$ to a set $Ought_m \subseteq H_m$.

The set $Ought_m$ contains the ideal histories passing through m

$$m/h \models \bigcirc\varphi \iff \forall h' \in Ought_m : m/h' \models \varphi$$

Refinement

Standard deontic models sometimes considered too crude: classification as ideal or nonideal.

Instead of ideal (0) / nonideal (1): each $h \in H_m$ is given a value representing the worth or desirability of h at m.

The set of values *val* can be arbitrary (real numbers, color codes, ...) but must be at least partially ordered by $\leq$.

A general deontic models is a tuple $\mathcal{M} = \langle \mathit{Mom}, <, \mathit{Choice}, \mathit{Value}, v \rangle$, where:

- $\langle \mathit{Mom}, <, \mathit{Choice}, v \rangle$ is a $BT + AC$ model;
- *Value* maps each moment $m \in \mathit{Mom}$ to a function $\mathit{Value}_m : H_m \longrightarrow \mathit{val}$.

Let $m \in \mathit{Mom}$ and $h, h' \in H_m$. $\mathit{Value}_m(h) \leq \mathit{Value}_m(h')$ means that h' is at least as desirable as h at m.

Truth value of ought statements

Let $\mathcal{M} = \langle Mom, <, Choice, Value, v \rangle$.

$\mathcal{M}, m/h \models \bigcirc\varphi \iff \exists h' \in H_m :$

$$\begin{cases} (1) & \mathcal{M}, m/h' \models \varphi \\ (2) & \forall h'' \in H_m : \text{ if } Value_m(h') \leq Value_m(h'') \text{ then } \mathcal{M}, m/h'' \models \varphi \end{cases}$$

(φ is true for some history, and φ is true for all histories at least as desirable.)

Utilitarian deontic models are obtained by adding two constraints.

Constraint 1: $\mathit{val} = \mathbb{R}$, and $\leq$ is the standard order over $\mathbb{R}$

Constraint 2: $\mathit{Value}_m(h) = \mathit{Value}_{m'}(h)$

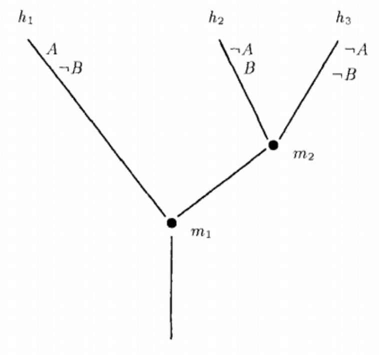
(We can omit the subscript.)

“Reparational” oughts

Obligations rising from violations of previous obligations.
Example ([Thomason 1984], [Horty 2001]):

- Suppose it ought to be the case at the moment m_1 that a will soon board a plane to visit his aunt.
- At the moment m_1, three histories unfold.
- In h_1, he boards the plane.
- In h_2, a does not board the plane and calls his aunt to tell her that he will not be visiting.
- In h_3, a does not board the plane and does not call his aunt to tell her that he will not be visiting.
- The letter A stands for the proposition that the agent will board the plane; the
- The letter B stands for the proposition that the agent will call his aunt to say that he is not coming.

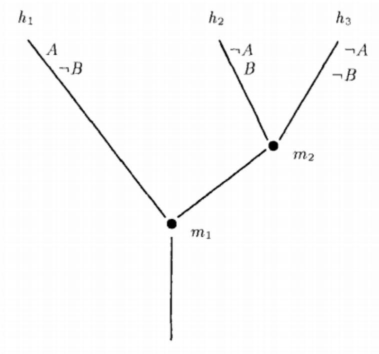
IDEAL OUGHTS



(Picture from [Horty 2001])

- $Ought_{m_1} = \{h_1\}$
- $Ought_{m_2} = \{h_2\}$
- $m_1/\_ \models \bigcirc A \wedge \neg \bigcirc B$
- $m_2/\_ \models \bigcirc B$

Utilitarian oughts



(Picture from [Horty 2001])

- $Value_{m_1}(h_1) = 10$
- $Value_{m_1}(h_2) = Value_{m_2}(h_2) = 4$
- $Value_{m_1}(h_3) = Value_{m_2}(h_3) = 0$
- $m_1/\_ \models \bigcirc A \wedge \neg \bigcirc B$
- $m_2/\_ \models \bigcirc B$

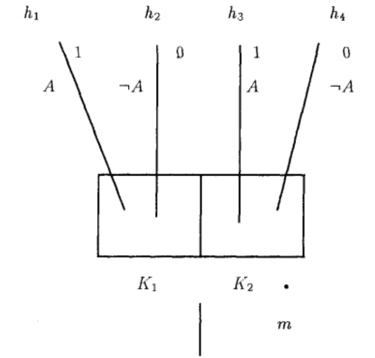
Originally Meinong, Nicolai Hartmann, ... but also Anderson, Kanger, ...

Roderick Chisholm suggests:

> *"S ought to bring it about that p" can be defined as "It ought to be that S brings it about that p."*
> *[Chisholm 1964, p. 150]*

Agent *a* ought to see to it that φ:

$$\bigcirc[a\,cstit : \varphi]$$



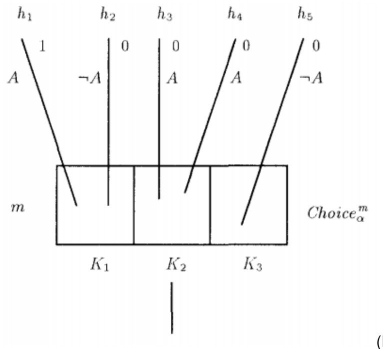
(Picture from [Horty 2001])

- $\bigcirc A$
- $\neg \bigcirc [a\, cstit : A]$

Logical principles of utilitarian deontic models

- $\bigcirc$ is a normal modal operator
- $\bigcirc\varphi \to \Diamond\varphi$
- $\bigcirc\varphi \to \Box \bigcirc \varphi$
- $\neg(\bigcirc[a\ cstit : \varphi] \wedge \bigcirc[b\ cstit : \neg\varphi])$
- $\bigcirc[a\ cstit : \varphi] \to \bigcirc\varphi$
  - Remark: $\bigcirc\varphi \to \bigcirc[a\ cstit : \varphi]$ is not valid
  - Remark: $\bigcirc\varphi \wedge \Diamond[a\ cstit : \varphi] \to \bigcirc[a\ cstit : \varphi]$ is not valid either! (next two slides)

- Karen, wishes to buy a horse, but she has only \$10,000 to spend and the horse she wants is selling for \$15,000;
- We imagine that Karen offers \$10,000 for the horse at the moment m (choice K_1);
- It is up to the owner of the horse to decide whether to accept the offer. The history h_1 represents a scenario in which the owner accepts Karen's offer, h_2 a scenario in which the offer is rejected;
- A is the statement that Karen will become less wealthy by the amount of \$10,000;
- The unique best history is h_1, in which the offer is accepted, and, as a consequence, Karen buys the horse and becomes less wealthy by \$10,000;
- Since Karen is less wealthy by \$10,000 in the unique best history, we must conclude that it ought to be that she is less wealthy by \$10,000;
- Of course, Karen also has the ability to see to it that she is less wealthy by \$10,000, (choice K_2);
- But we would not wish to conclude that Karen ought to see to it that she is less wealthy by \$10,000.



(Picture from [Horty 2001])

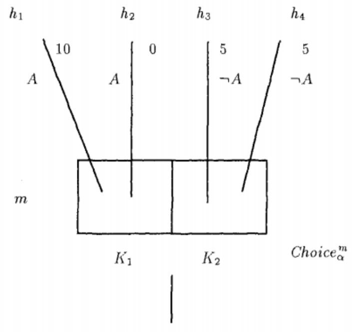
- $\bigcirc A$
- $\Diamond[a\, cstit : A]$
- $\neg \bigcirc [a\, cstit : A]$

Is $\bigcirc[a\ cstit: A]$ actually adequate to formalize that an agent *a* ought to see to it that *A*?

- ... it is entirely utilitarian.
- Horty: a statement that *a* ought to see to it that *A* often seems to be sensitive also to nonutilitarian considerations.

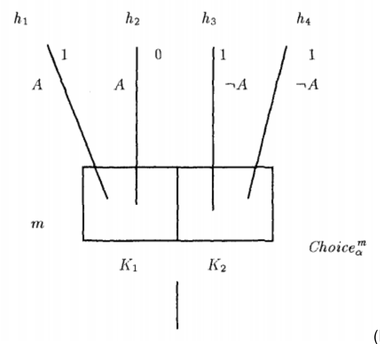
Is $\bigcirc[a\ cstit: A]$ at least adequate to formalize the utilitarian notion of an agent *a* ought to see to it that *A*?

- An agent *a* is faced with two options at the moment *m*: to gamble the sum of five dollars (K_1), or to refrain from gambling (K_2).
- If *a* gambles, there is a history in which he wins ten dollars, and another in which he loses his stake;
- If *a* does not gamble, he preserves his original stake;
- the utility associated with each history at *m* is entirely determined by the sum of money that *a* possesses at the end;
- The letter *A* stands for the proposition that *a* gambles;
- $\bigcirc[a\ cstit: A]$ holds at *m*.



(Picture from [Horty 2001])

If we change the utilities:



(Picture from [Horty 2001])

Then $\neg \bigcirc [a\, cstit : A]$. Good.
But we should expect that it is wise not to gamble here.
However, $\neg \bigcirc [a\, cstit : \neg A]$.

The model prescribes risk seeking obligations to the agents.

The models do not prescribe “bad” obligations, but they also miss some seemingly reasonable obligations.

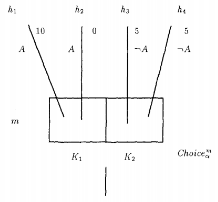
A proposition at the moment m is a subset $X \subseteq H_m$.

Definition (weak preference over propositions): $X \leq Y$ iff $\forall h \in X, \forall h' \in Y : Value_m(h) \leq Value_m(h')$.

A new "fused" deontic stit operator with ordered choices would be:

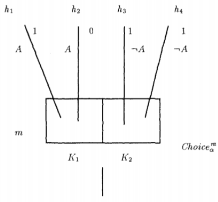
$m/h \models \bigoplus[a\, cstit : A]$ iff $\exists K \in Choice(a, m)$ such that (1) $\{m\} \times K \subseteq ||A||$ and (2) $\forall K' \in Choice(a, m) : K' \leq K$.

GAMBLING AGAIN



(Picture from [Horty 2001])

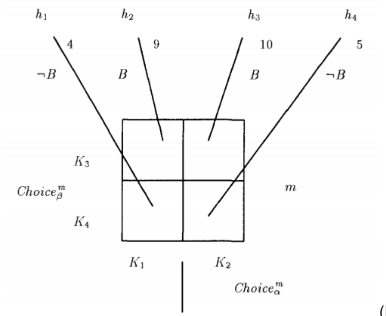
$\neg \bigoplus[a\, cstit : A] \wedge \neg \bigoplus[a\, cstit : \neg A]$



(Picture from [Horty 2001])

$\bigoplus[a\, cstit : \neg A]$

FURTHER PROBLEM WITH MULTIAGENCY



(Picture from [Horty 2001])

K_2 seems preferable, but it is not the case that $K_1 \leq K_2$.

We define:

$$\mathit{State}(a, m) = \mathit{Choice}(\mathrm{Agt} \setminus \{a\}, m)$$

The "strategic contexts" agent *a* might face.

When there are two players (e.g., on the previous example):

$$\mathit{State}(a, m) = \mathit{Choice}(b, m)$$

and

$$\mathit{State}(b, m) = \mathit{Choice}(a, m)$$

<u>Definition</u> (weak choice dominance): Let $K, K' \in \mathit{Choice}(a, m)$.
$K \preceq_a K'$ iff $K \cap S \leq K' \cap S$ for every $S \in \mathit{States}(a, m)$

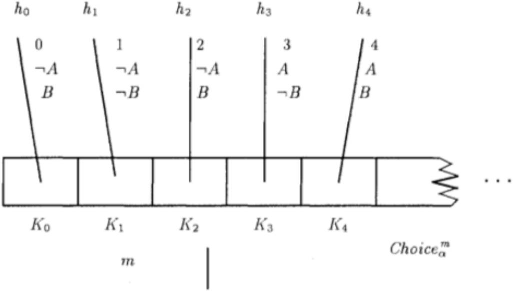
On the previous example: $K_1 \prec_a K_2$.

$$Optimal(a, m) = \{K \in Choice(a, m) \mid \nexists K' \in Choice(a, m), K \prec_a K'\}$$

When there is a finite number of choices, this works well:

$m/h \models \bigodot[a\, cstit\colon A]$ iff $\{m\} \times K \subseteq ||A||$ for every $K \in Optimal(a, m)$

Further problem with infinite repertoires of choices



(Picture from [Horty 2001])

We'd like to have $\odot[a\, cstit : A]$ and $\neg\odot[a\, cstit : \neg A]$.
But $Optimal(a, m) = \emptyset$...

$m/h \models \odot[a\, cstit : A]$ iff for every $K \in Choice(a, m)$, if $\{m\} \times K \not\subseteq ||A||$, then there is $K' \in Choice(a, m)$ such that:

(1) $K \prec_a K'$, and

(2) $\{m\} \times K' \subseteq ||A||$, and

(3) $\{m\} \times K'' \subseteq ||A||$ for each $K'' \in Choice(a, m)$ such that $K' \preceq_a K''$.

This is obligation to do.

What about?

$$[a\ cstit : \bigcirc[b\ cstit : \varphi]]$$

$$[a\ cstit : \bigcirc F[b\ cstit : \varphi]]$$

$$[a\ cstit : F \bigcirc [b\ cstit : \varphi]]$$

$$[a\ cstit : \odot[b\ cstit : \varphi]]$$

$$[a\ cstit : \odot F[b\ cstit : \varphi]]$$

$$[a\ cstit : F \odot[b\ cstit : \varphi]]$$

Well:

- $[a\, cstit : \bigcirc[b\, cstit : \varphi]]$ is just $\bigcirc[b\, cstit : \varphi]$
- $[a\, cstit : \bigcirc F[b\, cstit : \varphi]]$ is just $\bigcirc F[b\, cstit : \varphi]$
- $[a\, cstit : F \bigcirc [b\, cstit : \varphi]]$ is good
- $[a\, cstit : \odot[b\, cstit : \varphi]]$ is just $\odot[b\, cstit : \varphi]$
- $[a\, cstit : \odot F[b\, cstit : \varphi]]$ is not in our language!
- $[a\, cstit : F \odot[b\, cstit : \varphi]]$ is good

Objection?

Restricted complement thesis $\Rightarrow$ deontic statements must take agentives as their complements.

Some arguments against the simple logic for $\bigcirc$.

It worked with $\bigodot[a\,cstit: \varphi]$, but it is a fused operator, not exactly an ought with an agentive in its scope. Nonetheless, it shows that the models are amenable.

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