A New Twist to the Miners' Puzzle

Partly based on joint work with Jeroen Groenendijk and Floris Roelofsen

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SPE7

Miners

Kolodny and MacFarlane

The facts

- There are two mine shafts.
- Blocking the correct mine shaft saves all miners.
- Blocking the wrong mine shaft kills all miners.
- Blocking neither mine shaft kills one miner.

Desideratum 1

(1) We ought to block neither shaft. $\boxed{v}(\neg p' \wedge \neg q')$

Kolodny and MacFarlane

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Kolodny and MacFarlane

Premises

(2) a. The miners are in in shaft A or B. $p \vee q$

b. If the miners are in shaft A, we ought to block shaft A. $p \rightarrow \boxed{v} p'$

c. If the miners are in shaft B, we ought to block shaft B. $q \rightarrow \boxed{v} q'$

The problem

1. $(p \vee q) \wedge (p \rightarrow \boxed{v} p') \wedge (q \rightarrow \boxed{v} q')$

   does not entail ($\not\models$)

2. $\boxed{v}(\neg p' \wedge \neg q')$

Kolodny and MacFarlane

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2. $\boxed{V}(\neg p' \wedge \neg q')$

Kratzer Semantics

Modal base

- pp'
- qq'
- pq'
- qp'
- $p\overline{(p'q')}$
- $q\overline{(p'q')}$

The ordering

$pp', qq' > p\overline{(p'q')}, q\overline{(p'q')} > pq', qp'$

Characterization of obligation:

$\Box_V \varphi$ holds when the best worlds are φ worlds.

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More to be explained

Conditionals

(3) a. If the miners are in shaft A, we ought to block shaft A. $p \rightarrow \boxed{v}\, p'$

b. If the miners are in shaft B, we ought to block shaft B. $q \rightarrow \boxed{v}\, q'$

Desideratum 2:

$\boxed{v}\, p' \vee \boxed{v}\, q'$ does not hold.

Implicit arguments

Kratzer [ms]: assumption of ignorance

(4) a. Given that we don't know where the miners are, if the miners are in shaft A, we ought to block shaft A.
b. Given that we don't know where the miners are, if the miners are in shaft B, we ought to block shaft B

Cariani, Kaufmann, Schwager [2012]

"If the miners are in shaft A, we (still) ought to block neither shaft, for their being in shaft A doesn't mean that we know where they are. Indeed, no matter where the miners are, we ought to block neither shaft."

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The conditionals are not always acceptable

Kratzer: implicit that we will learn that the antecedent is the case

(5) a. If the miners are in shaft A, we ought to get sandbags right away and block it.
b. If the miners are in shaft A, we ought to act fast and block it before the miners suffocate.
c. If the miners are in shaft A, let's get sandbags and block it!

Recap

Desiderata:

1: $\boxed{\vee}(\neg p' \wedge \neg q')$ holds.

2: $\boxed{\vee} p' \vee \boxed{\vee} q'$ does not hold.

3: Explanation why the conditionals are not always acceptable.

Next

Reanalyzing the premises.

Innocuous premises

Restriction on actions

(6) We cannot block both shafts.
$\neg(p' \wedge q')$

Restriction on possibilities

(7) The miners are not in both shafts.
$\neg(p \wedge q)$

Making more rules explicit

Gambling with lives is immoral

(8) a. If it is possible that the miners are in shaft A, then we ought not to block shaft B. $\Diamond p \rightarrow \boxed{v}\neg q'$

b. If it is possible that the miners are in shaft B, then we ought not to block shaft A. $\Diamond q \rightarrow \boxed{v}\neg p'$

Intent

When $\Diamond p \wedge \Diamond q$ holds then $\boxed{v}(\neg p' \wedge \neg q')$ holds as well.

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When $\Diamond p \wedge \Diamond q$ holds then $\boxed{v}(\neg p' \wedge \neg q')$ holds as well.

Rejecting the original premises

Implicit: we need to know that p holds.

(9) a. If the miners **must** be in shaft A, we ought to block shaft A. $\Box p \rightarrow \boxed{v} p'$

b. If the miners **must** be in shaft B, we ought to block shaft B. $\Box q \rightarrow \boxed{v} q'$

Intent

- When $\Diamond\neg p$ holds, $\boxed{v} p'$ does not hold.
- When $\Diamond\neg q$ holds, $\boxed{v} q'$ does not hold.

Problem in Kratzer semantics

- When $\Box p$ does not hold, (9-a) vacuously holds.
- When $\Box q$ does not hold, (9-b) vacuously holds.

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Suppositional Inquisitive Semantics

Aims

Characteristics

- The semantics specifies when supposition failure occurs, for example when $s = \emptyset$.
- Modified Andersonian Deontic modals are raised to a suppositional semantics.
- Implication, suppositionally deontic may and epistemic might are structurally related.
- Epistemic might is a supposability check (similarly to Veltman's might as a consistency check.)
- Deontic and epistemic may and must are duals.

Logical language

A language of propositional logic

- Connectives $\neg, \wedge, \rightarrow$
- Epistemic modal possibility operator $\Diamond$
- Deontic modal permission operator $\Diamond_{\!V}$

Introduced by definition:

- $\Box\varphi := \neg\Diamond\neg\varphi$
- $\boxed{V}\varphi := \neg\Diamond_{\!V}\neg\varphi$

Information states

Worlds and rulings

- A world w is a valuation function such that for every atomic sentence p: $w(p) = 1$ (true) or $w(p) = 0$ (false).

  ω refers to the set of all possible worlds.

- A ruling r is a violation function such that for every world $w \in \omega$: $r(w) = 1$ (no violation) or $r(w) = 0$ (violation).

  ρ refers to the set of all possible rulings.

Global structure of the semantics

Recursive definition of three basic semantic relations:

1. $s \models^{+} \varphi$: state s supports φ
2. $s \models^{-} \varphi$: state s rejects φ
3. $s \models^{\circ} \varphi$: state s dismisses a supposition of φ

The proposition expressed by φ, $[\varphi]$, is determined by:

$$[\varphi] = \langle [\varphi]^{+}, [\varphi]^{-}, [\varphi]^{\circ} \rangle$$

where

$[\varphi]^{+}$ denotes $\{s \subseteq \omega | s \models^{+} \varphi\}$, and similarly for $[\varphi]^{-}$ and $[\varphi]^{\circ}$

Propositions and dismissal

A proposition is a triple $\mathcal{P} = \langle \mathcal{P}^+, \mathcal{P}^-, \mathcal{P}^\circ \rangle$ where:

- $\mathcal{P}^\circ$ is a downward closed set of states:
  if $s \in \mathcal{P}^\circ$ and $t \subseteq s$, then $t \in \mathcal{P}^\circ$
- $\mathcal{P}^+$ and $\mathcal{P}^-$ are not downward closed.
- $\mathcal{P}^+$ and $\mathcal{P}^-$ are mutually exclusive: $(\mathcal{P}^+ \cap \mathcal{P}^-) = \emptyset$
- $\mathcal{P}^+$ and $\mathcal{P}^-$ are consistent: $\emptyset \notin (\mathcal{P}^+ \cap \mathcal{P}^-)$
- If a state has no substate that supports or rejects $\mathcal{P}$, then a state suppositionally dismisses $\mathcal{P}$:
  if $\forall t \subseteq s: t \notin (\mathcal{P}^+ \cup \mathcal{P}^-)$, then $s \in \mathcal{P}^\circ$

Crucial fact:

Any proposition is suppositionally dismissed by the inconsistent state:
for all $\mathcal{P}$: $\emptyset \in \mathcal{P}^\circ$

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Supposability of alternatives

Alternatives for a proposition

$\textsc{alt}(\mathcal{P}) := \{s \in \mathcal{P}^+ \mid \text{there is no } t \in \mathcal{P}^+ \text{ such that } t \supset s\}$

Supposability

- Let $\alpha \in \textsc{alt}(\mathcal{P})$ (which implies that $\alpha \in \mathcal{P}^+$)
- Then we say that α is supposable in s, notation $s \lhd \alpha$,

  iff $\forall t$: if $\alpha \supseteq t \supseteq (\alpha \cap s)$, then $t \in \mathcal{P}^+$

Supposability implies consistency

- $s \lhd \alpha$ implies that $(\alpha \cap s) \neq \emptyset$

Deontic suppositional inquisitive semantics

Ordinary atomic sentences

- $s \models^{+} p$ iff $s \neq \emptyset$ and $\forall w \in worlds(s): w(p) = 1$
- $s \models^{-} p$ iff $s \neq \emptyset$ and $\forall w \in worlds(s): w(p) = 0$
- $s \models^{\circ} p$ iff $s = \emptyset$

The deontic predicate OK

- $s \models^{+} \mathtt{OK}$ iff $s \neq \emptyset$ and $\forall w \in worlds(s)$ and $\forall r \in rulings(s): r(w) = 1$
- $s \models^{-} \mathtt{OK}$ iff $s \neq \emptyset$ and $\forall w \in worlds(s)$ and $\forall r \in rulings(s): r(w) = 0$
- $s \models^{\circ} \mathtt{OK}$ iff $s = \emptyset$

Choosing directions in deontic states

s_1	w_1	w_2	w_4
r_1	11	10	00
r_2	11	10	00
r_3	11	10	00
r_4	11	10	00

s_2	w_1	w_2	w_4
r_5	11	10	00
r_6	11	10	00
r_7	11	10	00
r_8	11	10	00

Choosing directions in deontic states

s_1	w_1	w_2	w_4
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s_2	w_1	w_2	w_4
r_5	11	10	00
r_6	11	10	00
r_7	11	10	00
r_8	11	10	00

Negation, disjunction, conjunction

Negation

- $s \models^{+} \neg\varphi$ iff $s \models^{-} \varphi$
- $s \models^{-} \neg\varphi$ iff $s \models^{+} \varphi$
- $s \models^{\circ} \neg\varphi$ iff $s \models^{\circ} \varphi$

Disjunction

- $s \models^{+} \varphi \vee \psi$ iff $s \models^{+} \varphi$ or $s \models^{+} \psi$
- $s \models^{-} \varphi \vee \psi$ iff $s \models^{-} \varphi$ and $s \models^{-} \psi$
- $s \models^{\circ} \varphi \vee \psi$ iff $s \models^{\circ} \varphi$ or $s \models^{\circ} \psi$

Conjunction

- $s \models^{+} \varphi \wedge \psi$ iff $s \models^{+} \varphi$ and $s \models^{+} \psi$
- $s \models^{-} \varphi \wedge \psi$ iff $s \models^{-} \varphi$ or $s \models^{-} \psi$
- $s \models^{\circ} \varphi \wedge \psi$ iff $s \models^{\circ} \varphi$ or $s \models^{\circ} \psi$

Clauses for Implication

- $s \models^{+} \varphi \rightarrow \psi$ iff $\textsc{alt}[\varphi]^{+} \neq \emptyset$ and $\forall \alpha \in \textsc{alt}[\varphi]^{+}$:
  1. $s \lhd \alpha$, and
  2. $\alpha \cap s \models^{+} \psi$
- $s \models^{-} \varphi \rightarrow \psi$ iff $\textsc{alt}[\varphi]^{+} \neq \emptyset$ and $\exists \alpha \in \textsc{alt}[\varphi]^{+}$:
  1. $s \lhd \alpha$, and
  2. $\alpha \cap s \models^{-} \psi$
- $s \models^{\circ} \varphi \rightarrow \psi$ iff $\textsc{alt}[\varphi]^{+} = \emptyset$ or $\exists \alpha \in \textsc{alt}[\varphi]^{+}$:
  1. $s \not\lhd \alpha$, or
  2. $\alpha \cap s \models^{\circ} \psi$

Example

(10) If Mary sings, Sue will dance. $p \rightarrow q$

a. No, if Mary sings, Sue will not dance. $p \rightarrow \neg q$

b. Well, Mary won't sing. $\neg p$

Deontic Modals

Clauses for deontic modals

Deontic *may*

- $s \models^{+} \diamondsuit\!\!\!\vee \varphi$ iff $\textsc{alt}[\varphi]^{+} \neq \emptyset$ and $\forall\alpha \in \textsc{alt}[\varphi]^{+}$:
  1. $s \lhd \alpha$, and
  2. $\alpha \cap s \models^{+} \mathrm{OK}$
- $s \models^{-} \diamondsuit\!\!\!\vee \varphi$ iff $\textsc{alt}[\varphi]^{+} \neq \emptyset$ and $\forall\alpha \in \textsc{alt}[\varphi]^{+}$:
  1. $s \lhd \alpha$, and
  2. $\alpha \cap s \models^{-} \mathrm{OK}$
- $s \models^{\circ} \diamondsuit\!\!\!\vee \varphi$ iff $\textsc{alt}[\varphi]^{+} = \emptyset$ or $\exists\alpha \in \textsc{alt}[\varphi]^{+}$:
  1. $s \not\lhd \alpha$

Comparing deontic *may* and implication 1

Obvious difference

- The one difference is that the 'consequent' of *may* is not an arbitrary formula, but the deontic predicate OK.
  $s \models^+ \diamondsuit\varphi \iff s \models^+ \varphi \to \mathrm{OK}$
- The deontic predicate OK is atomic, so it is not suppositional.
- $s \models^+ (\varphi \vee \psi) \to \mathrm{OK} \iff s \models^+ \varphi \to \mathrm{OK} \wedge \psi \to \mathrm{OK}$, so
  $s \models^+ \diamondsuit(\varphi \vee \psi) \iff s \models^+ \diamondsuit\varphi \wedge \diamondsuit\psi$

Deontic free choice

Free choice

(11) a. A country may establish a research center or a laboratory.

b. $\diamondsuit\!\!\!\!\raisebox{0.1em}{\tiny v}\ (p \vee q)$

Support clause of $\diamondsuit_{v}\varphi$

- $s \models^{+} \diamondsuit_{v}\varphi$ iff $\textsc{alt}[\varphi]^{+} \neq \emptyset$ and $\forall\alpha \in \textsc{alt}[\varphi]^{+}$:
  1. $s \lhd \alpha$, and
  2. $\alpha \cap s \models^{+} \mathrm{OK}$

s_1	w_1	w_2	w_3	w_4
r_1	11	10	01	00
r_2	11	10	01	00

Table 1: $s_1 \models^{+} \diamondsuit_{v}(p \vee q)$

Comparing deontic *may* and implication

Crucial difference

- $s \models^{-} \diamondsuit\varphi$ iff $\textsc{alt}[\varphi]^{+} \neq \emptyset$ and $\forall\alpha \in \textsc{alt}[\varphi]^{+}$:
  1. $s \lhd \alpha$, and
  2. $\alpha \cap s \models^{-}$ OK
- $s \models^{-} \varphi \rightarrow \psi$ iff $\textsc{alt}[\varphi]^{+} \neq \emptyset$ and $\exists\alpha \in \textsc{alt}[\varphi]^{+}$:
  1. $s \lhd \alpha$, and
  2. $\alpha \cap s \models^{-} \psi$

Implications with support-inquisitive antecedents

(12) If Sue sings or Mary dances, then Pete will play the Piano.

a. No, if Sue sings, Pete will not play the Piano.

b. No, if Mary dances, Pete will not play the Piano.

Comparing deontic *may* and implication

Crucial difference

- $s \models^{-} \Diamond\!\!\!\!\!\!\bigcirc\!\!\!\!\!\!\!\vee\ \varphi$ iff $\textsc{alt}[\varphi]^{+} \neq \emptyset$ and $\forall \alpha \in \textsc{alt}[\varphi]^{+}$:
  1. $s \lhd \alpha$, and
  2. $\alpha \cap s \models^{-}$ OK
- $s \models^{-} \varphi \rightarrow \psi$ iff $\textsc{alt}[\varphi]^{+} \neq \emptyset$ and $\exists \alpha \in \textsc{alt}[\varphi]^{+}$:
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Deontic Free choice

Negating free choice

(13) a. A country may not establish a research center or a laboratory.

b. $\neg \diamondsuit_{\vee} (p \vee q)$

Reduced rejection clause of $\diamondsuit_{\vee} \varphi$

$s \models^{-} \diamondsuit_{\vee} \varphi$ iff $\textsc{alt}[\varphi]^{+} \neq \emptyset$ and $\forall \alpha \in \textsc{alt}[\varphi]^{+} : \alpha \cap s \models^{-} \text{OK}$

s_1	w_1	w_2	w_3	w_4
r_1	11	10	01	00
r_2	11	10	01	00

Table 2: $s_1 \models^{+} \neg \diamondsuit_{\vee} (p \vee q)$

Comparing deontic *may* and implication

Difference disappears, when φ is not support-inquisitive

- If φ is not support-inquisitive:

$$s \models^{-} \Diamond_{V} \varphi \iff s \models^{-} \varphi \rightarrow \mathrm{OK}$$

Taking the difference into account:

1. $s \models^{-} \Diamond_{V} \varphi \iff s \models^{+} \varphi \rightarrow \neg\mathrm{OK}$
2. $s \models^{+} \neg\Diamond_{V} \varphi \iff s \models^{+} \varphi \rightarrow \neg\mathrm{OK}$
3. $s \models^{+} \Box_{V} \varphi \iff s \models^{+} \neg\varphi \rightarrow \neg\mathrm{OK}$

Deontic Free choice

Dismissing a free choice prohibition

(14) a. A country may not establish a research center or a laboratory.

b. $\neg\Diamond(p \vee q)$

Reduced dismissal clause of $\Diamond\varphi$

$s \models^{\circ} \Diamond\varphi$ iff $\text{ALT}[\varphi]^{+} = \emptyset$ or $\exists\alpha \in \text{ALT}[\varphi]^{+} : \alpha \cap s = \emptyset$

Dismissal

(15) a. Well, no country will establish a research center.

b. $\neg p$

s_1	w_1	w_2	w_3	w_4
r_1	11	10	01	00
r_2	11	10	01	00

Deontic Free choice

Dismissing a free choice prohibition

(16) a. A country may not establish a research center or a laboratory.
b. $\neg \diamondsuit (p \vee q)$

Reduced dismissal clause of $\diamondsuit \varphi$

$s \models^{\circ} \diamondsuit \varphi$ iff $\textsc{alt}[\varphi]^{+} = \emptyset$ or $\exists \alpha \in \textsc{alt}[\varphi]^{+} : \alpha \cap s = \emptyset$

Dismissal

(17) a. Well, no country will establish a research center.
b. $\neg p$

s_1	w_1	w_2	w_3	w_4
r_1	11	10	01	00
r_2	11	10	01	00

Conditional obligation

Reduction to implication

$$s \models^{+} \boxed{v}\varphi \iff s \models^{+} \neg\varphi \rightarrow \neg \mathrm{OK}$$

Conditional permission

(18) a. If a country has a laboratory, it must establish a research center.

b. $p \rightarrow \boxed{v} q$

c. $p \rightarrow (\neg q \rightarrow \neg \mathrm{OK})$

d. $(p \wedge \neg q) \rightarrow \neg \mathrm{OK}$

Suppositional Inquisitive Semantics

Epistemic modals

Suppositional epistemic *might* and *must*

Might as a supposability check

- In InqS $\Diamond\varphi$ can be treated as a supposability check.
- In the most basic cases this boils down to a consistency check, like Veltman's *might* in update semantics (US).

Persistence

- For Veltman, $\Diamond\varphi$ is a basic example of a non-persistent update.
- InqS epistemic modals are support/reject-persistent modulo suppositional dismissal.

Necessary relations

Suppositionally dismissing supportability

- $s \models^{\otimes} \varphi$ iff $s \models^{\circ} \varphi$ and $s \not\models^{-} \varphi$ and $\forall t \subseteq s$: $t \not\models^{+} \varphi$.

For a non-suppositional φ

- $s \models^{\otimes} \varphi$ iff $s = \emptyset$.

Generally

- If $s \models^{\otimes} \varphi$, then no alternative for φ is supposable in s.

Suppositional *might*: the intuitive idea

$\Diamond\varphi$ is a proposal to check the supposability of φ in s

- s supports $\Diamond\varphi$ iff
  (a) there is at least one alternative for φ and
  (b) every alternative for φ is supposable in s
- s rejects $\Diamond\varphi$ iff
  (a) s does not suppositionally dismiss supportability of φ and
  (b) every alternative for φ is not supposable in s
- s dismisses a supposition of $\Diamond\varphi$ iff
  (a) there is no alternative for φ or
  (b) some alternative for φ is not supposable in s

SUPPOSITIONAL *might*: SUPPORT AND DISMISSAL

SUPPORT AND DISMISSING A SUPPOSITION CONTRADICT EACH OTHER

- s supports $\Diamond\varphi$ iff
  - (A) there is at least one alternative for φ and
  - (B) every alternative for φ is supposable in s
- s dismisses a supposition of $\Diamond\varphi$ iff
  - (A) there is no alternative for φ or
  - (B) some alternative for φ is not supposable in s

Suppositional *might*: rejection and dismissal

Rejection implies suppositional dismissal

- s rejects $\Diamond\varphi$ iff

  (a) s does not suppositionally dismiss supportability of φ and

  (b) every alternative for φ is not supposable in s

- s dismisses a supposition of $\Diamond\varphi$ iff

  (a) there is no alternative for φ or

  (b) some alternative for φ is not supposable in s

Suppositional *might*: persistence

Two essential features of the clauses for $\Diamond\varphi$

- Support and dismissing a supposition contradict each other
- Rejection implies dismissal

Support of *might* is defeasible

- It can be the case that $s \models^{+} \Diamond\varphi$ and that it holds for some more informed state $t \subset s$ that $t \not\models^{+} \Diamond\varphi$, or even $t \models^{-} \Diamond\varphi$, but then it will also be the case that $t \models^{\circ} \Diamond\varphi$.
- Despite the fact that suppositional *might* is support-defeasible, it is still support-persistent modulo suppositional dismissal.

Suppositional *might* spelled out

Epistemic *might*

$$s \models^{+} \Diamond\varphi \quad \text{iff} \quad \textsc{alt}(\varphi) \neq \emptyset \ \text{ and } \ \forall\alpha \in \textsc{alt}(\varphi) : s \lhd \alpha$$

$$s \models^{-} \Diamond\varphi \quad \text{iff} \quad s \not\models^{\otimes} \varphi \ \text{ and } \ \forall\alpha \in \textsc{alt}(\varphi) : s \ntriangleleft \alpha$$

$$s \models^{\circ} \Diamond\varphi \quad \text{iff} \quad \textsc{alt}(\varphi) = \emptyset \ \text{ or } \ \exists\alpha \in \textsc{alt}(\varphi) : s \ntriangleleft \alpha$$

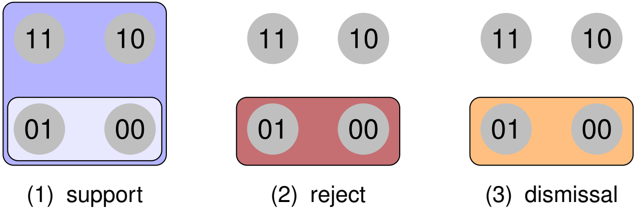

Figure 1: $\Diamond p$

Derived suppositional *must*

Must as a non-supposability check

- $\Box\varphi$ is defined as $\neg\Diamond\neg\varphi$
- So, $\Box\varphi$ is supported in s, when $\Diamond\neg\varphi$ is rejected in s
- $\Diamond\neg\varphi$ is a proposal to check for supposability of $\neg\varphi$ in s
- When the check for supposability of $\neg\varphi$ fails in s, $\Diamond\neg\varphi$ is rejected in s and $\Box\varphi$ is supported in s.
- Conversationally, a speaker proposing $\Box\varphi$, invites a responder to suppose that $\neg\varphi$, in the hope that in her state $\neg\varphi$ is (also) not supposable.

Solution

Back to the miners' puzzle

Back to the miners' puzzle

Premises:

(19)

a. The miners are in in shaft A or B. $p \vee q$

b. We cannot block both shafts. $\neg(p' \wedge q')$

c. The miners are not in both shafts. $\neg(p \wedge q)$

d. If the miners **must be** in shaft A, we ought to block shaft A. $\Box p \rightarrow \boxed{\vee} p'$

e. If the miners **must be** in shaft B, we ought to block shaft B. $\Box q \rightarrow \boxed{\vee} q'$

f. If it is possible that the miners are in shaft A, then we ought not to block shaft B. $\Diamond p \rightarrow \boxed{\vee} \neg q'$

g. If it is possible that the miners are in shaft B, then we ought not to block shaft A. $\Diamond q \rightarrow \boxed{\vee} \neg p'$

The aim

Desiderata:

1: $\boxed{v}(\neg p' \wedge \neg q')$ holds.

2: $\boxed{v} p' \vee \boxed{v} q'$ does not hold.

3: Explanation why the conditionals are not always acceptable.

We block neither shaft

Desideratum 1 : $\boxed{\vee}(\neg p' \wedge \neg q')$ holds.

(20)
a. The miners are in in shaft A or B. $p \vee q$
b. We cannot block both shafts. $\neg(p' \wedge q')$
c. The miners are not in both shafts. $\neg(p \wedge q)$
d. If it is possible that the miners are in shaft A, then we ought not to block shaft B. $\Diamond p \rightarrow \boxed{\vee}\neg q'$
e. If it is possible that the miners are in shaft B, then we ought not to block shaft A. $\Diamond q \rightarrow \boxed{\vee}\neg p'$

s_1	w_1	w_2	w_3	w_4	w_5	w_6
r_1	1001	0110	1010	0101	1000	0100
r_2	1001	0110	1010	0101	1000	0100
r_3	1001	0110	1010	0101	1000	0100
r_4	1001	0110	1010	0101	1000	0100

Table 5: $s \models^+ \boxed{\vee}(\neg p' \wedge \neg q') \Longleftrightarrow s \models^+ (p' \rightarrow \neg \mathrm{OK}) \wedge (q' \rightarrow \neg \mathrm{OK})$

What if we learn that p holds?

New premises

(21) a. The miners are in shaft A. p

b. If it is possible that the miners are in shaft B, then we ought not to block shaft A. $\Diamond q \to \boxed{v}\neg p'$

s_2	w_1	w_2	w_3	w_4	w_5	w_6
r_1	1001	0110	1010	0101	1000	0100
r_2	1001	0110	1010	0101	1000	0100
r_3	1001	0110	1010	0101	1000	0100
r_4	1001	0110	1010	0101	1000	0100
r_5	1001	0110	1010	0101	1000	0100
r_6	1001	0110	1010	0101	1000	0100
r_7	1001	0110	1010	0101	1000	0100
r_8	1001	0110	1010	0101	1000	0100

What if we learn that p holds?

New premises

(22) a. The miners are in shaft A. p

b. If it is possible that the miners are in shaft B, then we ought not to block shaft A. $\Diamond q \rightarrow \boxed{v}\neg p'$

s_2	w_1	w_2	w_3	w_4	w_5	w_6
r_1	1001	0110	1010	0101	1000	0100
r_2	1001	0110	1010	0101	1000	0100
r_3	1001	0110	1010	0101	1000	0100
r_4	1001	0110	1010	0101	1000	0100
r_5	1001	0110	1010	0101	1000	0100
r_6	1001	0110	1010	0101	1000	0100
r_7	1001	0110	1010	0101	1000	0100
r_8	1001	0110	1010	0101	1000	0100

What if we learn that p holds?

New premises

(23) a. The miners are in shaft A. p

b. If it is possible that the miners are in shaft B, then we ought not to block shaft A. $\Diamond q \rightarrow \boxed{\vee}\neg p'$

s_2	w_1	w_2	w_3	w_4	w_5	w_6
r_1	1001	0110	1010	0101	1000	0100
r_2	1001	0110	1010	0101	1000	0100
r_3	1001	0110	1010	0101	1000	0100
r_4	1001	0110	1010	0101	1000	0100
r_5	1001	0110	1010	0101	1000	0100
r_6	1001	0110	1010	0101	1000	0100
r_7	1001	0110	1010	0101	1000	0100
r_8	1001	0110	1010	0101	1000	0100

When we find out that the miners are in Shaft A, the obligation to block neither becomes void.

We shouldn't gamble

Desideratum 2: $\boxed{v}p' \vee \boxed{v}q'$ does not hold.

(24)
a. The miners are in in shaft A or B. $p \vee q$
b. We cannot block both shafts. $\neg(p' \wedge q')$
c. The miners are not in both shafts. $\neg(p \wedge q)$
d. If the miners must be in shaft A, we ought to block shaft A. $\Box p \rightarrow \boxed{v}p'$
e. If the miners must be in shaft B, we ought to block shaft B. $\Box q \rightarrow \boxed{v}q'$

s_1	w_1	w_2	w_3	w_4	w_5	w_6
r_1	1001	0110	1010	0101	1000	0100
r_2	1001	0110	1010	0101	1000	0100
r_3	...	...	...	...	...	...

What if we learn that p holds?

Premises

(25)

a. The miners are in shaft A. p

b. We cannot block both shafts. $\neg(p' \wedge q')$

c. The miners are not in both shafts. $\neg(p \wedge q)$

d. If the miners must be in shaft A, we ought to block shaft A. $\Box p \rightarrow \boxed{v}\, p'$

e. If the miners must be in shaft B, we ought to block shaft B. $\Box q \rightarrow \boxed{v}\, q'$

s_2	w_1	w_2	w_3	w_4	w_5	w_6
r_1	1001	0110	1010	0101	1000	0100
r_2	1001	0110	1010	0101	1000	0100

Defeasiblity

Desideratum 3

Why aren't the conditionals always acceptable?

Reinterpreting the conditionals

(26) a. If the miners must be in shaft A, we ought to block shaft A. $\Box p \rightarrow \boxed{V} p'$

b. If the miners must be in shaft B, we ought to block shaft B. $\Box q \rightarrow \boxed{V} q'$

Cleo Condoravdi an Sven Lauer (a.o): epistemic necessity over the antecedent in conditionals

(27) Anankastic: If you want to go to Harlem, you have to take the A-train.

DEFEASIBLITY

DESIDERATUM 3

Why aren't the conditionals always acceptable?

REINTERPRETING THE CONDITIONALS

(26) a. If the miners must be in shaft A, we ought to block shaft A. $\Box p \rightarrow \boxed{\vee} p'$

b. If the miners must be in shaft B, we ought to block shaft B. $\Box q \rightarrow \boxed{\vee} q'$

CLEO CONDORAVDI AN SVEN LAUER (A.O): EPISTEMIC NECESSITY OVER THE ANTECEDENT IN CONDITIONALS

(27) Anankastic: If you want to go to Harlem, you have to take the A-train.

The end (Or is it?)

Thank you for listening

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