A logic for pragmatic intrusion

Maria Aloni
ILLC & Philosophy
University of Amsterdam
M.D.Aloni@uva.nl

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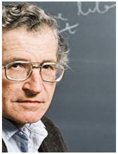
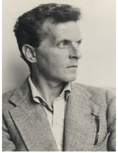
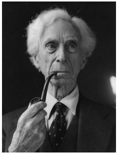
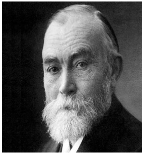
Logic and Language

Formal semantics

- Uses logic to study linguistic meaning
- Roots in logic, philosophy of language and theoretical linguistics



- Indirect method: semantic data explained via translation

$$\text{Natural Language} \mapsto \text{Logical Language} \Rightarrow \text{Models}$$

- Many challenges: How to collect semantic data in a reliable way? How to translate natural language expressions into a logical language in a systematic and compositional way? But also which logic should we adopt?

The challenge of free choice (FC)

- Classical examples of FC inferences:

(1) Deontic FC inference [Kamp 1973]

a. You may go to the beach *or* to the cinema.
b. $\rightsquigarrow$ You may go to the beach *and* you may go to the cinema.

(2) Epistemic FC inference [Zimmermann 2000]

a. Mr. X might be in Victoria *or* in Brixton.
b. $\rightsquigarrow$ Mr. X might be in Victoria *and* he might be in Brixton.

- Logical rendering of FC inferences:

(3) $\Diamond(\alpha \vee \beta) \rightsquigarrow \Diamond\alpha \wedge \Diamond\beta$ (NB: $\Diamond\alpha \wedge \Diamond\beta \neq \Diamond(\alpha \wedge \beta)$)

Invalid in classical modal logic

The paradox of free choice

- Free choice permission in natural language:

(4) You may (A or B) $\rightsquigarrow$ You may A

- But (5) not valid in standard deontic logic (von Wright 1968):

(5) $\Diamond(\alpha \vee \beta) \to \Diamond\alpha$ [Free Choice Principle]

- Plainly making the Free Choice Principle valid, for example by adding it as an axiom, would not do (Kamp 1973):

(6)
1. $\Diamond a$ [assumption]
2. $\Diamond(a \vee b)$ [from 1, by classical reasoning]
3. $\Diamond b$ [from 2, by free choice principle]

- The step leading to 2 in (6) uses the following valid principle:

(7) $\Diamond\alpha \to \Diamond(\alpha \vee \beta)$ [Modal Addition]

- Natural language counterpart of (7), however, seems invalid:

(8) You may A $\not\rightsquigarrow$ You may (A or B) [Ross's paradox]

$\Rightarrow$ Intuitions on natural language in direct opposition to the principles of classical logic

Reactions to paradox

- Paradox of Free Choice Permission:

(9)
1. $\Diamond a$ [assumption]
2. $\Diamond(a \vee b)$ [from 1, by modal addition]
3. $\Diamond b$ [from 2, by FC principle]

- Pragmatic solutions [$\Rightarrow$ keep logic as is]
  - FC inferences are conversational implicatures [Grice], i.e. pragmatic inferences derived as the product of rational interactions between cooperative language users (assuming classical logic meanings)
  - $\Rightarrow$ step leading to 3 is unjustified
- Semantic solutions [$\Rightarrow$ change the logic]
  - FC inferences are semantic entailments
  - $\Rightarrow$ step leading to 3 is justified, but step leading to 2 is no longer valid
- Free choice: semantics or pragmatics?
- My proposal: a logic-based account beyond canonical semantics vs pragmatics divide
  - Next to semantic entailments (ruled by classical logic), also pragmatic factors are modeled and the additional inferences deriving by their interaction: $\Diamond(\alpha \vee \beta)^+ \models \Diamond\alpha$, but $\Diamond(\alpha \vee \beta) \not\models \Diamond\alpha$
  - (Modal) addition will fail but only for pragmatically enriched formulas
  - Upshot logic-based account: hybrid behaviour naturally derived

Free choice: semantics or pragmatics

Argument against semantic accounts of FC

Free choice effects systematically disappear in negative contexts:

(10) Dual Prohibition (Alonso-Ovalle 2005)

a. You are not allowed to eat the cake or the ice-cream
$\rightsquigarrow$ You are not allowed to eat either one

b. $\neg\Diamond(\alpha \vee \beta) \rightsquigarrow \neg\Diamond\alpha \wedge \neg\Diamond\beta$

- Unexpected on a semantic account where $\Diamond(\alpha \vee \beta) \models \Diamond\alpha \wedge \Diamond\beta$
- Predicted by pragmatic accounts: pragmatic inferences do not embed under logical operators

Free choice: semantics or pragmatics

Argument against pragmatic accounts of FC

Free choice effects embeddable under universal quantification:

(11) Universal FC (Chemla 2009)

a. All of the boys may go to the beach or to the cinema.
$\rightsquigarrow$ All of the boys may go to the beach and all of the boys may go to the cinema.

b. $\forall x \Diamond(\alpha \vee \beta) \rightsquigarrow \forall x(\Diamond\alpha \wedge \Diamond\beta)$

- Unexpected on a pragmatic account: pragmatic inferences do not embed under logical operators
- Predicted by semantic accounts where $\Diamond(\alpha \vee \beta) \models \Diamond\alpha \wedge \Diamond\beta$

Free choice: semantics or pragmatics

Argument against most accounts

Free choice effects also arise with wide scope disjunctions:

(12) Wide Scope FC (Zimmermann 2000)

a. Detectives may go by bus or they may go by boat. $\rightsquigarrow$ Detectives may go by bus and may go by boat.

b. Mr. X might be in Victoria or he might be in Brixton. $\rightsquigarrow$ Mr. X might be in Victoria and might be in Brixton.

c. $\Diamond\alpha \vee \Diamond\beta \rightsquigarrow \Diamond\alpha \wedge \Diamond\beta$

Free choice: summary data and predictions

(13)
a. $\Diamond(\alpha \vee \beta) \rightsquigarrow \Diamond\alpha \wedge \Diamond\beta$ [Narrow Scope FC]
b. $\neg\Diamond(\alpha \vee \beta) \rightsquigarrow \neg\Diamond\alpha \wedge \neg\Diamond\beta$ [Dual Prohibition]
c. $\forall x\Diamond(\alpha \vee \beta) \rightsquigarrow \forall x(\Diamond\alpha \wedge \Diamond\beta)$ [Universal FC]
d. $\Diamond\alpha \vee \Diamond\beta \rightsquigarrow \Diamond\alpha \wedge \Diamond\beta$ [Wide Scope FC]

	N Scope FC	Dual Prohibition	Universal FC	W Scope FC
Semantic	yes	no	yes	no
Pragmatic	yes	yes	no	no

Free choice: semantics or pragmatics?

- A purely semantic or pragmatic approach cannot account for this complex pattern of inference
- I propose a hybrid approach where
  - FC inference derived by allowing pragmatic principles intrude in the recursive process of meaning composition
- Intruding pragmatic principle will be a version of Grice Quality maxim, modeled by NE, the non-emptiness atom from team logic

Team-based modal logics

- Team logic: formulas interpreted wrt a set of points of evaluation (a team) rather than one single point (Yang and Väänänen, 2017)

Classical vs team-based modal logic

$[M = \langle W, R, V\rangle]$

- Classical modal logic: (truth in worlds)

$$M, w \models \phi, \text{ where } w \in W$$

- Team-based modal logic:

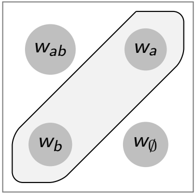
$$M, t \models \phi, \text{ where } t \subseteq W$$

Bilateral state-based modal logic (BSML)

- teams $\mapsto$ information states
- assertion/rejection conditions are modeled rather than truth

$$M, s \models \phi, \text{ ``}\phi \text{ is assertable in } s\text{''}, \quad \text{with } s \subseteq W$$
$$M, s \mathrel{=\mkern-3mu|} \phi, \text{ ``}\phi \text{ is rejectable in } s\text{''}, \quad \text{with } s \subseteq W$$

Information states: partiality and linguistic applications



(a) $\not\models a$; $\not\models \neg a$

- Information states/teams: less determinate than possible worlds
  - comparable to truthmakers, situations, possibilities, ...
- Partial nature makes state-based systems particularly suitable for capturing phenomena at the semantics-pragmatics interface:
  - Dynamic semantics (Groenendijk, Stokhof, Veltman, Dekker): anaphora, presupposition, ...
  - Inquisitive semantics (Groenendijk, Roelofsen, Ciardelli): questions, indefinites, ...
  - Bilateral state-based modal logic (BSML): **pragmatic intrusion**, epistemic contradictions, ...

Pragmatic intrusion in BSML

Main ingredient: $\textsc{ne}$

- Conversation is ruled by a principle which prescribes to avoid contradictions, 'avoid $\bot$'
- 'Avoid $\bot$' follows from Grice QUALITY maxim: 'make your contribution one that is true'
- In team-based logic we can use $\textsc{ne}$ to model 'avoid $\bot$':
  - In classical logic, no non-trivial way to model 'avoid $\bot$': $\neg\bot = \top$
  - In team-based logic: $\emptyset \mapsto$ state of logical insanity, supports every classical formula including contradictions: $\emptyset \models p \wedge \neg p$
  - $\textsc{ne}$ models 'avoid $\bot$' by requiring the supporting state to be non-empty:

$$M, s \models \textsc{ne} \quad \text{iff} \quad s \neq \emptyset$$

- Pragmatic enrichment defined in terms of a systematic intrusion of 'avoid $\bot$' (formalised by $\textsc{ne}$) in the recursive process of meaning composition

Pragmatic intrusion in BSML

Main ingredient: pragmatic enrichment

- Pragmatically enriched formulas α^+ come with the requirement to satisfy $\textsc{ne}$ ('avoid $\bot$') distributed along each of their subformulas:

$$\begin{array}{rcl} p^+ & = & p \wedge \textsc{ne} \\ (\neg\alpha)^+ & = & \neg\alpha^+ \wedge \textsc{ne} \\ (\alpha \vee \beta)^+ & = & (\alpha^+ \vee \beta^+) \wedge \textsc{ne} \\ (\alpha \wedge \beta)^+ & = & (\alpha^+ \wedge \beta^+) \wedge \textsc{ne} \\ (\Diamond\alpha)^+ & = & \Diamond\alpha^+ \wedge \textsc{ne} \end{array}$$

- Main result: pragmatic enrichment has non-trivial effect only on positive disjunctions:
  - $\mapsto$ we derive $\textsc{fc}$ effects (for pragmatically enriched formulas);
  - $\mapsto$ pragmatic enrichment vacuous under negation.

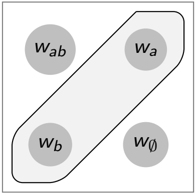
Pragmatic intrusion in BSML

Main ingredient: split disjunction

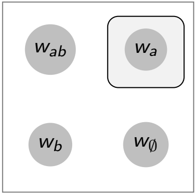
- s supports $\phi \vee \psi$ iff s is the union of two substates, each supporting one of the disjuncts:

  $$M, s \models \phi \vee \psi \text{ iff } \exists t, t' : t \cup t' = s \ \& \ M, t \models \phi \ \& \ M, t' \models \psi$$

- Effect of pragmatic enrichment: $(\alpha \vee \beta)^+ \equiv (\alpha \wedge \mathrm{NE}) \vee (\beta \wedge \mathrm{NE})$
- s supports $(\alpha \vee \beta)^+$ iff s is the union of two **non-empty** substates, each supporting one of the disjuncts.



(b) $\models$ $(a \vee b)$; and $\models$ $(a \vee b)^+$



(c) $\models$ $(a \vee b)$; but $\not\models$ $(a \vee b)^+$

- Pragmatically enriched disjunctions require both disjuncts to be **live possibilities**

Pragmatic intrusion in BSML

Main results

- By pragmatically enriching every formula, we derive:
  - Narrow scope FC: $\Diamond(\alpha \vee \beta)^+ \models \Diamond\alpha \wedge \Diamond\beta$
  - Wide scope FC: $(\Diamond\alpha \vee \Diamond\beta)^+ \models \Diamond\alpha \wedge \Diamond\beta$ (with restrictions)
  - Universal FC: $\forall x \Diamond(\alpha \vee \beta)^+ \models \forall x(\Diamond\alpha \wedge \Diamond\beta)$
  - Distribution: $\forall x(\alpha \vee \beta)^+ \models \exists x\alpha \wedge \exists x\beta$ and more
- while no undesirable side effects obtain with other configurations:
  - Dual prohibition: $\neg\Diamond(\alpha \vee \beta)^+ \models \neg\Diamond\alpha \wedge \neg\Diamond\beta$

Resulting picture

- Empirically correct
  - Subtle predictions confirmed by pilot experiments
- Cognitively plausible
  - Common assumption: the interpretation of a sentence leads to the creation of a picture of the world (modeled here by info states);
  - BSML shows that FC inference follows from the assumption that in creating such pictures language users systematically disregard $\emptyset$;
  - A fact which can be explained by a general preference in human cognition for concrete (non-empty) vs abstract representations.

Bilateral State-Based Modal Logic (BSML)

Language

$$\phi \quad := \quad p \mid \neg\phi \mid \phi \vee \phi \mid \phi \wedge \phi \mid \Diamond\phi \mid \mathrm{NE}$$

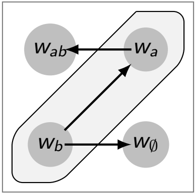
where $p \in A$.

Models and States

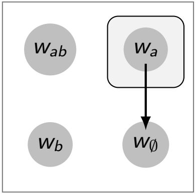
- Classical Kripke models: $M = \langle W, R, V \rangle$
- States: $s \subseteq W$, sets of worlds in a Kripke model

Examples

for $A = \{a, b\}$



(d) $\not\models a$; $\models \Diamond a$



(e) $\models a$; $\not\models \Diamond a$

Semantic clauses

$[M = \langle W, R, V \rangle;\ s, t, t' \subseteq W]$

$$
\begin{array}{rcl}
M, s \models p & \text{iff} & \forall w \in s : V(w, p) = 1 \\
M, s \dashv p & \text{iff} & \forall w \in s : V(w, p) = 0 \\
M, s \models \neg\phi & \text{iff} & M, s \dashv \phi \\
M, s \dashv \neg\phi & \text{iff} & M, s \models \phi \\
M, s \models \phi \vee \psi & \text{iff} & \exists t, t' : t \cup t' = s \ \&\ M, t \models \phi \ \&\ M, t' \models \psi \\
M, s \dashv \phi \vee \psi & \text{iff} & M, s \dashv \phi \ \&\ M, s \dashv \psi \\
M, s \models \phi \wedge \psi & \text{iff} & M, s \models \phi \ \&\ M, s \models \psi \\
M, s \dashv \phi \wedge \psi & \text{iff} & \exists t, t' : t \cup t' = s \ \&\ M, t \dashv \phi \ \&\ M, t' \dashv \psi \\
M, s \models \Diamond\phi & \text{iff} & \forall w \in s : \exists t \subseteq R[w] : t \neq \emptyset \ \&\ M, t \models \phi \\
M, s \dashv \Diamond\phi & \text{iff} & \forall w \in s : M, R[w] \dashv \phi \\
M, s \models \mathrm{NE} & \text{iff} & s \neq \emptyset \\
M, s \dashv \mathrm{NE} & \text{iff} & s = \emptyset
\end{array}
$$

where $R[w] = \{v \in W \mid wRv\}$

Box

- $\Box\phi := \neg\Diamond\neg\phi$

$$
\begin{array}{lll}
M, s \models \Box\phi & \text{iff} & \text{for all } w \in s : M, R[w] \models \phi \\
M, s \dashv \Box\phi & \text{iff} & \text{for all } w \in s : \text{there is a } t \subseteq R[w] : t \neq \emptyset \ \&\ M, t \dashv \phi
\end{array}
$$

where $R[w] = \{v \in W \mid wRv\}$

Logical consequence

- $\phi \models \psi$ iff for all M, s : $M, s \models \phi \;\Rightarrow\; M, s \models \psi$

Pragmatic enrichment

For NE-free ϕ, $(\phi)^+$ defined as follows:

$$
\begin{array}{rcl}
p^+ & = & p \wedge \mathrm{NE} \\
(\neg\alpha)^+ & = & \neg\alpha^+ \wedge \mathrm{NE} \\
(\alpha \vee \beta)^+ & = & (\alpha^+ \vee \beta^+) \wedge \mathrm{NE} \\
(\alpha \wedge \beta)^+ & = & (\alpha^+ \wedge \beta^+) \wedge \mathrm{NE} \\
(\Diamond\alpha)^+ & = & \Diamond\alpha^+ \wedge \mathrm{NE}
\end{array}
$$

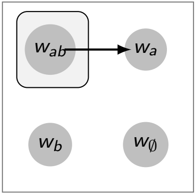
BSML: Free Choice effects

- s supports $\Diamond\phi$ iff for all $w \in s$: there is a non-empty subset of the set of worlds accessible from w which supports ϕ:

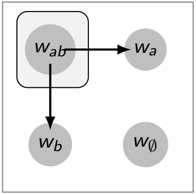
$$M, s \models \Diamond\phi \quad \text{iff} \quad \text{for all } w \in s : \text{there is } t \subseteq R[w] : t \neq \emptyset \ \& \ M, t \models \phi$$

$\Rightarrow$ Free choice effect derived in combination with enriched disjunctions:

$$\Diamond(\alpha \vee \beta)^+ \models \Diamond\alpha \wedge \Diamond\beta$$



(f) $\models \Diamond(a \vee b)$; but $\not\models \Diamond(a \vee b)^+$



(g) $\models \Diamond(a \vee b)^+$

- $\Diamond(\alpha \vee \beta)^+$ requires both α and β to be live possibilities in $R[w]$, for all $w \in s$

BSML: bilateral negation

- Negation ($\neg$) defined in terms of rejection:

$$
\begin{array}{lcl}
M, s \models \neg\phi & \text{iff} & M, s \mathrel{=}\joinrel\mathrel{|} \phi \\
M, s \mathrel{=}\joinrel\mathrel{|} \neg\phi & \text{iff} & M, s \models \phi
\end{array}
$$

- Some classical validities:

$$
\begin{array}{rcll}
\phi & \equiv & \neg\neg\phi & \text{(Double Negation Elimination)} \\
\neg(\phi \vee \psi) & \equiv & \neg\phi \wedge \neg\psi & \text{(De Morgan Laws)} \\
\neg(\phi \wedge \psi) & \equiv & \neg\phi \vee \neg\psi & \\
\neg\Box\phi & \equiv & \Diamond\neg\phi & \text{(Duality)} \\
\neg\Diamond\phi & \equiv & \Box\neg\phi &
\end{array}
$$

- Non-classical behaviour: failure of replacement under $\neg$

$$\phi \equiv \psi \not\Rightarrow \neg\phi \equiv \neg\psi$$

- Despite (or better because of) this non-classical behaviour, empirically correct predictions for pragmatic enrichments in negative contexts

BSML: tautologies and contradictions

- Strong
  - $\top := p \vee \neg p$ always supported
  - $\bot := \mathrm{NE} \wedge \neg\mathrm{NE}$ never supported
- Weak
  - NE supported by all non-empty states
  - $\neg\mathrm{NE}$ supported only by empty state

Effect of negation

$$
\begin{tikzcd}
\top \arrow[dr, no head] & & \bot \arrow[dl, no head] \\
& \neg \arrow[dl] \arrow[dr] & \\
\mathrm{NE} & \neg \arrow[l] \arrow[r] & \neg\mathrm{NE}
\end{tikzcd}
$$

- Failure of replacement under $\neg$:
  - $\neg\top \equiv \neg\mathrm{NE}$, but $\neg\neg\top \not\equiv \neg\neg\mathrm{NE}$;
  - $\neg\bot \equiv \mathrm{NE}$, but $\neg\neg\bot \not\equiv \neg\mathrm{NE}$.

BSML: Negation and pragmatic enrichment

Failure of replacement under negation

$$\phi \equiv \psi \not\Rightarrow \neg\phi \equiv \neg\psi$$

Linguistic evidence for replacement failure

- $\textsc{fc}$ effects disappear under negation (Dual Prohibition), so pragmatic enrichment should be vacuous under $\neg$:

$$\neg\alpha^+ \equiv \neg\alpha$$

- But, there is linguistic evidence showing that speakers draw $\textsc{fc}$ inferences under double negation, so pragmatic enrichment should not be vacuous there (Santorio and Romoli 2019):

$$\neg\neg\alpha^+ \not\equiv \neg\neg\alpha$$

- Without replacement failure these two desiderata would be impossible to satisfy.

Negation and pragmatic enrichment: proofs

Pragmatic enrichment vacuous under single negation

Let α be a positive sentence, then

$$\neg\alpha^{+} \equiv \neg\alpha$$

Proof: By induction on α.

- $\phi = p$. $\neg p^{+} \equiv \neg(p \wedge \mathrm{NE}) \equiv \neg p \vee \neg\mathrm{NE} \equiv \neg p$
- ...

Pragmatic enrichment not vacuous under double negation

$$\neg(\neg\alpha)^{+} \equiv \neg\neg\alpha^{+} \not\equiv \neg\neg\alpha$$

Proof: $\neg(\neg p)^{+} \equiv \neg\neg p^{+} \equiv \neg(\neg p^{+} \wedge \mathrm{NE}) \equiv \neg\neg p^{+} \vee \neg\mathrm{NE} \equiv \neg\neg p^{+} \equiv p^{+} \equiv p \wedge \mathrm{NE}$

Crucial facts exploited in proofs:

- $\neg(\phi \wedge \mathrm{NE}) \equiv \neg\phi \vee \neg\mathrm{NE} \equiv \neg\phi$, but
- $\neg\neg(\phi \wedge \mathrm{NE}) \equiv \phi \wedge \mathrm{NE} \not\equiv \phi \equiv \neg\neg\phi$

Negation and pragmatic enrichment: some predictions

- FC effects disappear under single negation (Dual Prohibition):

$$(\neg\Diamond(\alpha \vee \beta))^+ \models \neg\Diamond\alpha \wedge \neg\Diamond\beta$$

- But are preserved under double negation:

$$(\neg\neg\Diamond(\alpha \vee \beta))^+ \models \Diamond\alpha \wedge \Diamond\beta$$

- Logically equivalent sentences can have different pragmatic effects (detachability):

$$\begin{array}{rcl} \neg\alpha \vee \neg\beta & \equiv & \neg(\alpha \wedge \beta) \\ (\neg\alpha \vee \neg\beta)^+ & \not\equiv & (\neg(\alpha \wedge \beta))^+ \end{array}$$

- Only disjunctions gives rise to FC effects:

$$\begin{array}{rcl} (\Diamond(\neg\alpha \vee \neg\beta))^+ & \models & \Diamond\neg\alpha \\ (\Diamond\neg(\alpha \wedge \beta))^+ & \not\models & \Diamond\neg\alpha \end{array}$$

Results propositional BSML

Before pragmatic intrusion

- The NE-free fragment of BSML is equivalent to classical modal logic: $\alpha \models_{BSML} \beta$ iff $\alpha \models_C \beta$ (α, β are NE-free)
- But we can capture infelicity of epistemic contradictions by putting constraints on epistemic accessibility relation:
  1. Epistemic contradiction: $\Diamond\alpha \wedge \neg\alpha \models \bot$ (if R is state-based)
  2. Non-factivity: $\Diamond\alpha \not\models \alpha$

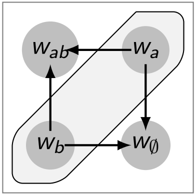
After pragmatic intrusion

- FC inferences derived for pragmatically enriched disjunction:
  - Narrow scope FC: $\Diamond(\alpha \vee \beta)^+ \models \Diamond\alpha \wedge \Diamond\beta$
  - Wide scope FC: $(\Diamond\alpha \vee \Diamond\beta)^+ \models \Diamond\alpha \wedge \Diamond\beta$ (if R is indisputable)
  - Modal disjunction: $(\alpha \vee \beta)^+ \models \Diamond\alpha \wedge \Diamond\beta$ (if R is state-based)
- Only disjunctions in positive environments affected by pragmatic intrusion:
  - Dual prohibition: $\neg\Diamond(\alpha \vee \beta)^+ \models \neg\Diamond\alpha \wedge \neg\Diamond\beta$
  - Double negation: $\neg\neg\Diamond(\alpha \vee \beta)^+ \models \Diamond\alpha \wedge \Diamond\beta$

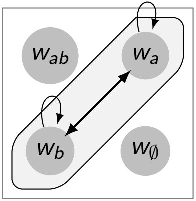
BSML: state-sensitive constraints on accessibility relation

- State-sensitive constraints on accessibility relation:
  - R is indisputable in (M, s) iff $\forall w, v \in s : R[w] = R[v]$
    $\mapsto$ all worlds in s access exactly the same set of worlds
  - R is state-based in (M, s) iff $\forall w \in s : R[w] = s$
    $\mapsto$ all and only worlds in s are accessible within s

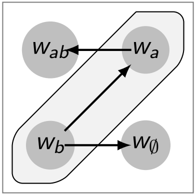
  where $R[w] = \{v \in W \mid wRv\}$



(h) indisputable



(i) state-base (and so also indisputable)



(j) neither

- Difference deontic vs epistemic modals captured by different properties of accessibility relation:
  - Epistemics: R is state-based (gives us $\Diamond\alpha \wedge \neg\alpha \models \bot$)
  - Deontics: R is possibly indisputable (gives us wide scope FC)

Applications: epistemic contradiction

Epistemic contradiction and non-factuality

1. $\Diamond\alpha \wedge \neg\alpha \models \bot$ [if R is state-based]
2. $\Diamond\alpha \not\models \alpha$ [even if R is state-based]

Epistemics vs deontics

- Differ wrt properties of accessibility relation:
  - Epistemics: R is state-based
  - Deontics: R is possibly indisputable (e.g. in performative uses)
- Epistemic contradiction predicted for epistemics, but not for deontics:

(14) #It might be raining and it is not raining. (Veltman, Yalcin)

(15) You don't smoke but you may smoke.

Applications: epistemic free choice

Narrow scope and wide scope FC

1. $\Diamond(\alpha \vee \beta)^+ \models \Diamond\alpha \wedge \Diamond\beta$
2. $(\Diamond\alpha \vee \Diamond\beta)^+ \models \Diamond\alpha \wedge \Diamond\beta$ [if *R* is indisputable]

Epistemic modals

- *R* is state-based, therefore always indisputable:

  (16) He might either be in London or in Paris. [+fc, narrow]

  (17) He might be in London or he might be in Paris. [+fc, wide]

- $\Rightarrow$ narrow and wide scope FC always predicted for pragmatically enriched epistemics

Applications: deontic free choice

Narrow scope and wide scope FC

1. $\Diamond(\alpha \vee \beta)^+ \models \Diamond\alpha \wedge \Diamond\beta$
2. $(\Diamond\alpha \vee \Diamond\beta)^+ \models \Diamond\alpha \wedge \Diamond\beta$ [if R is indisputable]

Deontic modals

- R may be indisputable if speaker is knowledgable (e.g. in performative uses)
- Predictions:
  - $\Rightarrow$ narrow scope FC always predicted for enriched deontics
  - $\Rightarrow$ wide scope FC only if speaker knows what is permitted/obligatory
- Further consequence: all cases of (overt) FC cancellations involve a wide scope configuration

(18) You may either eat the cake or the ice-cream, I don't know which (you may eat). [wide, –fc]

(19) You may either eat the cake or the ice-cream, I don't care which (you eat). [narrow, +fc]

Conclusions

- Free choice: a mismatch between logic and language
- Grice's insight:
  - stronger meanings can be derived using general principles of conversation
- Standard implementation: two separate components
  - Semantics: classical logic
  - Pragmatics: Gricean reasoning

  Elegant picture, but, when applied to FC, empirically inadequate
- My proposal: pragmatic enrichment in BSML
  - Literal meanings (NE-free fragment) + pragmatic principles (NE) $\Rightarrow$ FC and related inferences
  - NE stands for 'avoid $\bot$' $\leftrightsquigarrow$ 'neglect $\emptyset$'
- Future research:
  - Logic: proof theory (Anttila 2021); first order extension (van Ormondt and Aloni); bimodal perspective (Aloni, Baltag, van Benthem, Bezhanishvili)
  - Language: testing of predictions (experimental); analysis of overt FC cancellations (theoretical); explore more consequences of 'neglect $\emptyset$' and its cognitive plausibility.

Appendix: FC effects under double negation

- Due to Romoli and Santorio (2019)
- Presupposition of second disjunct (Maria can go to study in Japan) does not project/filtered by negation of first disjunct in (20):

(20) a. Either Maria can't go study in Tokyo or Boston, or she is the first in our family who can go to study in Japan (and the second who can go to study in the States).

b. $\neg\Diamond(a \vee b) \vee \phi_{\Diamond a}$

- Assuming that a disjunction $\phi \vee \psi_P$ presupposes $\neg\phi \rightarrow P$, predicted presupposition for (20) is:

(21) $\neg\neg\Diamond(a \vee b) \rightarrow \Diamond a$

- In bilateral accounts of narrow scope FC, (21) is a tautology (double negations cancel each other out and free choice inference is computed). Filtering is correctly predicted.