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October 27-28, 2012

Deriving indirectness and questioning entailment for epistemic *must*[1]

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(1) **Epistemic *must***
It **must** be raining.
Breakdown *must*(ϕ); here, ϕ = *it is raining* (also called the *prejacent*)

1 Two observations

1. *Must* requires **indirect evidence**: (1) is only okay if we see people coming inside with wet umbrellas, not if we are standing in the downpour

   Also, other strong epistemic modals **work the same way**, in English (*has to, gotta*) and other languages (*devoir* in French, *bu de bu* in Mandarin)

2. *Must* often sounds **tentative/hedged** (Karttunen (1972))

   But *must* is also used in mathematical proofs where the prejacent is necessarily true

2 Three questions

1. **Indirectness:** *Why* does *must* require indirect evidence? How should we capture this generalization throughout English and across languages?

2. **Entailment:** What is the logical relationship between *must*(ϕ) and ϕ?

   Weak *must:* $\phi \Rightarrow$ *must*(ϕ)? (Karttunen (1972), Kratzer (1981))

   Strong *must:* *must*(ϕ) $\Rightarrow \phi$? (von Fintel & Gillies (2010))

   Or are they apples and oranges?

3. How does **indirectness** relate to **entailment**?

   Should we derive **weak *must***'s logical weakness from indirectness?

   Or are indirectness and entailment independent? (von Fintel & Gillies (2010))

[1]Thanks to Chris Potts for advising this project, Anastasia Giannakidou for the seminar that gave rise to it, Peet Klecha for discussion, and the Stanford SemPrag Group for comments. Any errors are my own.

2.1 Game plan

- Overview one prominent analysis from each side:

  Kratzer's **weak *must***

  von Fintel and Gillies' **strong *must***

  Suggest that neither is fully satisfactory

- Show that Kratzer's analysis can be tweaked to be consistent with **weak, strong** or **neither**

  By defining epistemic *must* parallel to deontic *must*

- Suggest that the question of **strong/weak *must*** is not coherent

  And mull over how assertions relate to truth

3 Some representative answers

3.1 Kratzer

Anatomy of a modal (from Kratzer (1977))

Parameters

Lexical parameter:

$\forall$ (for, e.g., *must*; necessity) or $\exists$ (*might*; possibility)

Contextual parameters:

Modal base, W: the set of worlds being quantified over
Circumstantial modal base = all worlds consistent with the circumstances
Epistemic modal base = all worlds consistent with what is known, etc.

Ordering source, g: ranks the worlds in W
by how well they conform to some contextual criteria

General frame for *must*(ϕ)

$\forall w' \in W$ *such that* $w' \leq_{g(w)}, [[\phi(w')]] = 1$

Prose: In all worlds in the modal base and ranked above some standard by the ordering source, the prejacent is true.

Kratzer's analysis of epistemic *must*:

It must be raining.

Prejacent: It is raining

Contextual parameters:

W : what is known

g : ranks worlds by how well they comply with **indirect and potentially unreliable information** such as *what I remember hearing on the weather report this morning* or *what I estimate based on the humidity*

Interpretation: $\forall w' \in W$ *such that* $w' \leq_{g(w)}$, *it is raining* in w'

3.1.1 Upshot

Must is **weak** *because* the ordering source allows **unreliable** information

Must needs **indirectness** *because* the ordering source allows **indirect** information

Unreliable/indirect ordering source gives rise to both **indirectness** and **weakness**

3.2 von Fintel and Gillies

3.2.1 Key claims:

Indirectness is INDEPENDENT of **weakness** (*against* Kratzer's analysis)

Must is **strong**:

(2) x is an integer and x/2 is even: therefore, x must also be even

(3) It must be raining ??but it might not be.

(4) **Bonnie** (*seeing people's wet umbrellas*): It must be raining.
Sharese: You're wrong! It was raining earlier but it stopped.
Bonnie: ??I didn't say it *was* raining, I just said it *must* be raining! Stop picking on me!

They propose the following **denotation** for a **strong *must*** that requires indirect evidence independent of logical strength

Definition: strong *must* + evidentiality (adapted from von Fintel & Gillies (2010): 372)

Contextual parameters: Fix a kernel K, which represents direct information in the context, and a modal base B, and find the subset of B, $\mathbf{B(K)}$, which is the modal base minus the kernel of direct evidence.

i. $[[must(\phi)]]^{c,w}$ is defined only if K does not directly settle $[[\phi]]^c$
ii. if defined, $[[must(\phi))]]^{c,w} = 1 iff\ B(K) \subseteq [[\phi]]^c$

Prose: must ϕ is **defined** only if the direct evidence does not directly settle ϕ, and **true** only if the indirect evidence $B(K)$ entails the prejacent.

Illustration: *it must be raining* is
defined only if the direct evidence does not settle whether it is raining, and
true only if the indirect evidence (wet umbrellas) entails that it is raining.

3.2.2 Upshot

Convincing argument that **indirectness** and **logical entailment** are separate concepts

But have they really shown that *must* **must** be strong? Or just that it **can** be strong? (as Portner objects in their footnote, p. 16)

> Maybe you can conclude that *it must be raining* using unreliable information
> but conclude that *x must be even* based on foolproof reasoning

Indirectness is now stipulated; is "non-directly-settled information" (B(K)) a natural class?

Their denotation is

> a "**placeholder**"
> "for the eventual solution to the **mystery**"
> of why this "pairing of epistemic modals with an indirect inference signal"
> persists throughout English and across languages
> (all quotations from p. 368, footnote)

4 My proposal

Modify Kratzer's proposal to derive indirectness **separate from** logical strength/weakness

Using:

(5) **Deontic *must***
You **must** not litter.

Currently, epistemic *must* is analyzed quite differently from deontic *must*:

Table 1: Traditional analyses of epistemic and deontic *must*

Modal force	**Modal base**	**Ordering source**
epistemic	what is known	questionable assumptions (Kratzer), stereotypicality, or none (von Fintel and Gillies)
deontic	the circumstances	compliance with a body of rules

4.1 The intuition

Analyzing epistemic and deontic *must* differently obfuscates **what they share:**

> **Both epistemic and deontic *must*** invoke a body of **rules:**
> Normative rules for deontic *must* – e.g. *do not litter*
> Descriptive rules for epistemic *must* – e.g. *wet umbrellas indicate rain*

Analyzing epistemic *must* more like deontic *must* **derives indirectness requirement**

> **independent** of strength/weakness
> therefore, compatible with analyzing *must* as **strong, weak** or **neither**

4.2 The details

(6) **Definition: *rule***
A logical relationship between two sets of worlds

Table 2: Normative and descriptive rules

General form	Example	Prose
$P \Rightarrow Q$	wet umbrellas ⇒ rain	wet-umbrella worlds are rain worlds
$P(w') \Rightarrow Q(w')$	good(w') ⇒ no-litter(w')	good worlds are non-littering worlds

To capture this similarity, I propose the denotations below:

Deontic *must*
Contextual parameters: Fix a circumstantial modal base B and an ordering source g selecting all the worlds compatible with some normative rules
$[[\textbf{must } (\phi)]]^{B,f,w} = \textbf{1 } \textit{iff } \forall w' \in B \leq_{g(w)}, [[\phi(w')]] = 1$

Epistemic *must*
Contextual parameters: Fix a circumstantial modal base B and an ordering source g selecting all the worlds compatible with some descriptive rules
$[[\textbf{must } \phi]]^{B,f,w} = \textbf{1 } \textit{iff } \forall w' \in B \leq_{g(w)}, [[\phi(w')]] = 1$

A lemma:
There is **no meaningful difference between circumstantial and epistemic modal base**
Circumstantial: true/known facts; can be restricted in context
Epistemic: true/known facts; can be restricted in context

Foreshadowing:
true/known according to the *speaker* or some other contextually relevant party
Not just true in the actual world

4.3 Deriving indirectness

Main idea:

Epistemic *must* involves moving from facts about **this world** to a claim about **all worlds consistent with those facts**

To generalize, one needs **a generalization that maps facts to the things that follow from them**

The facts only support the prejacent **when mediated by this generalization: indirectly.**

Felicitous use of *must*

1. Know certain facts in the actual world: *see people come in with wet umbrellas*
2. Know a rule mapping these facts to things that always follow from them: *wet umbrellas mean rain*
3. Conclude: in *all worlds* consistent with the facts of *this world*, it is raining.

Infelicitous use of *must*

1. Know certain facts about the actual world: *see raindrops falling from the sky*
2. Know a rule mapping these facts to things that always follow from them
   - **tautological; rain entails rain*

5 What about entailment?

This denotation is compatible with:
Weak *must*, if the **descriptive generalizations are fallible**
Strong *must*, if the **descriptive generalizations are known to be true**

Just depends how you define the ordering source

So, which to choose?
My answer: Presupposition failure!

5.1 Strong vs. weak *must* is a false dichotomy

(7) **Definition: Strong claim**
Given two claims P and Q, the **stronger claim** is the one that is **true in fewer worlds**

(8) **Entailment: A special kind of strength**
If $P \Rightarrow Q$, then Q-worlds $\subset$ P-worlds
If P-worlds $\subset$ Q-worlds, then $\mid P\text{-worlds} \mid < \mid Q\text{-worlds} \mid$
Prose: If P is a subset of Q, then P has fewer elements than Q
So P is stronger than Q

So, to see if *must*(ϕ) is **weaker** or **stronger** than ϕ, we ask:

(*must*(ϕ)-worlds) $\subset$ (ϕ-worlds)?

(ϕ-worlds) $\subset$ (*must*(ϕ)-worlds)?

Problems

Circularity

Have to define *must*(ϕ) to know whether *must*(ϕ) worlds are a subset of ϕ worlds
But have to know whether *must*(ϕ) worlds are a subset of ϕ worlds to define *must*(ϕ)

Appropriateness vs. truth

The only data we **really** have is:

contexts where ASSERT(*must*(ϕ)) is appropriate (indirect evidence for ϕ)
vs. contexts where ASSERT(ϕ) is appropriate (direct evidence for ϕ)
But indirect-evidence worlds and direct-evidence contexts worlds do not overlap

Need subset relationship to assess *strength*
but can't have a subset relationship if the sets don't overlap

So *strength* is not meaningful here

Context-sensitivity

Epistemic *must* invokes **body of rules** that the speaker **thinks she knows**

It is interpreted relative to the **beliefs** of some party **determined in context**

The strength/weakness dichotomy does not take this into account

Does *must*(ϕ) entail ϕ?
is like asking
does *I know that Barack Obama is the president* entail *Barack Obama is the President*?
I think so,
but I might be wrong

Maybe you can say *must*(ϕ) when you might be wrong
But, you can also say ϕ when you might be wrong

We cannot draw conclusions about **actual world** based on **the speaker's subjective beliefs**
Must invokes **the speaker's subjective beliefs**
So we cannot conclude whether *must*(ϕ)-worlds are also ϕ-worlds

Similarly: "Speakers express a variety of conclusions, some logical, some defeasible. Sometimes they express them using epistemic *must*, but the data suggests that this use does not reflect the different logical status of conclusions." (Stone (1994): 3)

See also: Matthewson *et al.* (2008), Giannakidou & Mari (2012) for evidence that *must* encodes evidentiality, independent of logical strength

5.2 Upshot

Maybe the entailment question is so controversial and tricky
because it is not really a coherent question

6 Conclusion

Subtly modifying Kratzer's system – to treat epistemic *must* more like deontic *must* –
derives indirectness

Turning to **strength/weakness**:

The proposed analysis is consistent with **strong** *must* AND **weak** *must*

To choose one (or neither), we must tease apart propositions that are:

true in **actual world**

believed to be true in some party's **mental world**

pragmatically appropriate assertions in the context

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