Explaining exhaustivity in terms of Attentional Quantity

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Aim: a better account of exhaustivity

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A: John.  
(Exh.: not Mary, not Bill)
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I-Quantity: *assert all relevant truths.*
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Aims of this talk:

► discuss five serious problems for the standard recipe;
► show how the attention-based account easily solves them.
Problems for the standard recipe

**Standard recipe:** for some relevant, non-asserted alternative \( \varphi \):

- \( \neg \Box \varphi \) (maxim of I-Quantity)
- \( \Box \varphi \lor \Box \neg \varphi \) (competence/opinionatedness assumption)
- \( \Box \neg \varphi \) (exhaustivity)
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**Problems:**

A. Exh. without a competence assumption (Westera ’13).

B. Exh. without I-Quantity (Fox ’14).

C. The symmetry problem (e.g., Kroch 1972).

D. Exh. without informational intent (e.g., Biezma & Rawlins ’12).

E. Informationally equivalent utterances may yield different exh. (e.g., Van Rooij & Schulz ’06).

The new, A-Quantity-based account should solve these.

This talk will not cover:

F. embedded exhaustivity (e.g., Chierchia et al. 2012).

Except insofar as problem E seems to involve embedded exh.
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Outline

1. “Destructive” problems (A,B,C)

2. “Constructive” problems (D,E)

3. Formal, attention-based account

4. Discussion
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2. “Constructive” problems (D,E)

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4. Discussion
1.1. Problem A: exh. without a competence assumption

Purported evidence *for* reliance on competence assumption:

(Soames 1982)

(2) Q: Who (of John, Mary and Bill) was at the party?
   A: Not sure, but John was there... (no exh.)

Experimental variants (Breheny et al. 2013, Goodman et al. 2013):

(3) Instruction: A does not have complete knowledge about who was there.
   A: John was there. (no/weaker exh.)

Not convincing (Westera 2013). What they should have tested:

(4) Q: You may not know this, but who (of John, Mary and Bill) was at the party?
   A: John and Mary. (Exh.: Bill wasn’t)
1.1. Problem A: exh. without a competence assumption

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(Discussion?)
1.2. Problem B: exh. without I-Quantity

A quizmaster’s hint (Fox 2014):

(5) There is money in box 20 or 25.  

(Exh.: not both)
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Exhaustivity seems to be present:

(6) What you said was wrong. You said there was money in box 20 OR box 25, but in fact there was money in both boxes.
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But ignorance implication due to I-Quantity is absent:

(7) # You haven’t been completely honest. You said there was money in box 20 OR box 25, but in fact you knew where the money was.
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Outline of solution:

▶ Quizmaster will pretend only to be less informed about the quiz;
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▶ hence the I-Quantity implication (¬□) can be pretense;
▶ but exhaustivity (□¬) cannot be pretense.

This works for any account of exh. that bypasses I-Quantity.
1.3. Problem C: The symmetry problem (1/2)

Kroch, 1972 (a.o.):

- If relevance is symmetrical (closed under negation),
- then I-Quantity will imply both \( \neg \Box \varphi \) and \( \neg \Box \neg \varphi \),

Is relevance necessarily symmetrical?

"That seems like a natural, hard-to-avoid assumption" (e.g., Chierchia et al. 2012);
"Of course not, why would it be?!" (e.g., Horn 1989, Leech 1981).

(8)

(A sees B confidently leave the house without an umbrella...)

A: It's going to rain!
A: It's not going to rain!

Given this, there may not even be a symmetry problem here:

(9) Q: Who (of John, Mary and Bill) was at the party?
A: John and Mary.
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(10) Q: I need to know (of these five people here) who was present and who was absent.
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(10) Q: I need to know (of these five people here) who was present and who was absent.
   A: John was present, and Mary was present.

Q: Wow, only two?! That's disappointing!

Let us assume that:

▶ exhaustivity indeed occurs;
▶ the symmetry cannot be broken by brevity/complexity.

Starting point of solution:

▶ relative to (10Q), (10A) will imply a contradiction;
▶ for basically any account of exhaustivity;
▶ hence, (10A) cannot be cooperatively addressing (10Q);
▶ it must be addressing some other question instead,
▶ as part of a strategy for (10Q) (Roberts, 1996).

Now what could this strategic question be?

and why?
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- hence, (10A) cannot be cooperatively addressing (10Q);
- it must be addressing some other question instead,
- as part of a *strategy* for (10Q) (Roberts, 1996).

Now what could this strategic question be?
1.4. Problem C: The *real* symmetry problem (2/2)

(10) Q: I need to know (of these five people here) who was present and who was absent.
   A: John was present, and Mary was present.
   Q: Wow, only two?! That’s disappointing!

Let us assume that:
   ▶ exhaustivity indeed occurs; and
   ▶ the symmetry cannot be broken by brevity/complexity.

**Starting point of solution:**
   ▶ relative to (10Q), (10A) will imply a contradiction;
     ▶ for basically *any* account of exhaustivity;
   ▶ hence, (10A) cannot be cooperatively addressing (10Q);
   ▶ it must be addressing some other question instead,
   ▶ as part of a *strategy* for (10Q) (Roberts, 1996).

Now what could this strategic question be? and why?
1.5. Problem C: The *real* symmetry problem (2/2)

(11) Q: I need to know (of these five people here) who was present and who was absent.
A: John was present, and Mary was present.
Q: Wow, only two?! That’s disappointing!

Solution:
1.5. Problem C: The *real* symmetry problem (2/2)

(11) Q: I need to know (of these five people here) who was present and who was absent.
   A: John was present, and Mary was present.
   Q: Wow, only two?! That’s disappointing!

Solution:

- A split the prior question into:
  (i) “Who was present?”
  (ii) “Who was absent?”
Q: I need to know (of these five people here) who was present and who was absent.
A: John was present, and Mary was present.
Q: Wow, only two?! That’s disappointing!

Solution:
A split the prior question into:
(i) “Who was present?”
(ii) “Who was absent?”
(cf. accent placement)
1.5. Problem C: The *real* symmetry problem (2/2)

(11) Q: I need to know (of these five people here) who was present and who was absent.
A: John was present, and Mary was present.
Q: Wow, only two?! That’s disappointing!

Solution:

- A split the prior question into:
  
  (i) “Who was present?”
  (ii) “Who was absent?”

  (cf. accent placement)

- enabling A to address only (i) explicitly,
1.5. Problem C: The *real* symmetry problem (2/2)

(11) Q: I need to know (of these five people here) who was present and who was absent.
A: John was present, and Mary was present.
Q: Wow, only two?! That’s disappointing!

**Solution:**

- A split the prior question into:
  1. “Who was present?”
  2. “Who was absent?”

(cf. accent placement)

- enabling A to address only (i) explicitly,
- and (ii) by means of exhaustivity implicature.
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Brevity plays a role after all!
Q: I need to know (of these five people here) who was present and who was absent.
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Brevity plays a role after all!

In sum: the symmetry problem solves the symmetry problem.
1. “Destructive” problems (A,B,C)

2. “Constructive” problems (D,E)

3. Formal, attention-based account

4. Discussion
2.1. Problem D: exh. without an informational intent

Questions lack a main informational intent for I-Quantity to apply to:

Examples:

(12) Was John there, or Mary?

Exh.: not both, and no one else that's relevant

Towards a new account:

▶ Questions do serve to draw attention to things;
▶ hence a maxim of "A-Quantity" might do the trick...

A-Quantity:

draw attention to all relevant possibilities.

(Discuss: is exh. on questions and assertions the same phenomenon?)
2.1. Problem D: exh. without an informational intent

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  - **A-Quantity**: *draw attention to all relevant possibilities.*
2.1. Problem D: exh. without an informational intent

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  - **A-Quantity**: *draw attention to all relevant possibilities*.

(Discuss: is exh. on questions and assertions the same phenomenon?)
2.2. Problem E: informationally equivalent utterances [...]

Utterances with (supposedly) the same main informational intent can yield different exhaustivity implications:
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▶ building on Ciardelli et al. 2009.

in a way that “A-Quantity” may be sensitive to.
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Towards a solution: (13a,b,c) are attentionally distinct...
   ▶ building on Ciardelli et al. 2009.

in a way that “A-Quantity” may be sensitive to.

(Comparison:
   ▶ Hamblin, Aloni ’06, Van Rooij and Schulz ’06, Alonso-Ovalle ’6.)
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Utterances with (supposedly) the same main informational intent can yield different exhaustivity implications:

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Towards a solution: (13a,b,c) are attentionally distinct...


in a way that “A-Quantity” may be sensitive to.

(Comparison:
- Hurford 1974; Katzir & Singh 2013.)
2.3. Interim summary

Problems:
A. Exhaustivity without a competence assumption;
B. Exhaustivity without I-Quantity (quiz);
C. The symmetry problem;
D. Exhaustivity without informational intent;
E. Informationally equivalent utterances may yield different exh.
2.3. Interim summary

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Solutions:
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**Solutions:**

- solution to A is not quite clear yet;
- B can be solved by *any* account bypassing I-Quantity;
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**Solutions:**

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C. The symmetry problem;
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**Solutions:**

- solution to A is not quite clear yet;
- B can be solved by *any* account bypassing I-Quantity;
- C solves itself, given Roberts’s strategies;
- D and E point to a new recipe based on *A-Quantity*.
Outline

1. “Destructive” problems (A,B,C)

2. “Constructive” problems (D,E)

3. Formal, attention-based account

4. Discussion
3.1. Warming-up: information-maxims

**I-maxims:** For an informational intent $p$ and a QUd $Q$: 

\[ I\text{-Quality}(p) = □ ∨ p \]
\[ I\text{-Relation}(Q, p) = Q(p) \]
\[ I\text{-Quantity}(Q, p) = \forall q ((I\text{-Quality}(q) ∧ I\text{-Relation}(Q, q)) → (p ⊆ q)) \]

Alternative, equivalent formulation of $I\text{-Quantity}$:

\[ I\text{-Quantity}(Q, p) = \forall q ((Q(q) ∧ p ⊆ q) → ¬ □ ∨ q) \]

▶ The starting point for the standard recipe.
3.1. Warming-up: information-maxims

**I-maxims:** For an informational intent $p$ and a QUD $Q$:

$I$-Quality($p$) = $\Box \land p$

Alternative, equivalent formulation of $I$-Quantity:

$I$-Quantity($Q$, $p$) = $\forall q ((Q(q) \land p \not\subseteq q) \rightarrow \neg \Box \lor q)$

The starting point for the standard recipe.
3.1. Warming-up: information-maxims

**I-maxims:** For an informational intent $p$ and a QUD $Q$:

\[
\begin{align*}
\text{I-Quality}(p) &= \Diamond \vee p \\
\text{I-Relation}(Q, p) &= Q(p)
\end{align*}
\]
3.1. Warming-up: information-maxims

**I-maxims:** For an informational intent $p$ and a $QUD$ $Q$:

\[
\begin{align*}
I\text{-Quality}(p) &= \Box \lor p \\
I\text{-Relation}(Q, p) &= Q(p) \\
I\text{-Quantity}(Q, p) &= \forall q \left( (I\text{-Quality}(q) \land I\text{-Relation}(Q, q)) \rightarrow (p \subseteq q) \right)
\end{align*}
\]
3.1. Warming-up: information-maxims

**I-maxims:** For an informational intent $p$ and a $\text{QUUD } Q$:

- **I-Quality**($p$) = $\square \uparrow p$
- **I-Relation**($Q, p$) = $Q(p)$
- **I-Quantity**($Q, p$) = $\forall q \left( (\text{I-Quality}(q) \land \text{I-Relation}(Q, q)) \rightarrow (p \subseteq q) \right)$

Alternative, equivalent formulation of I-Quantity:

- **I-Quantity**($Q, p$) = $\forall q \left( (Q(q) \land p \not\subseteq q) \rightarrow \neg \square \uparrow q \right)$
3.1. Warming-up: information-maxims

**I-maxims:** For an informational intent \( p \) and a \( \text{QUID} \) \( Q \):

\[
\begin{align*}
\text{l-Quality}(p) &= \square \lor p \\
\text{l-Relation}(Q, p) &= Q(p) \\
\text{l-Quantity}(Q, p) &= \forall q \left( \left( \text{l-Quality}(q) \land \text{l-Relation}(Q, q) \right) \rightarrow (p \subseteq q) \right)
\end{align*}
\]

Alternative, equivalent formulation of I-Quantity:

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\text{l-Quantity}(Q, p) = \forall q \left( (Q(q) \land p \not\subseteq q) \rightarrow \neg \square \lor q \right)
\]

- The starting point for the standard recipe.
3.2. Attention maxims

**A-maxims**: For an attentional intent $A$ and a QUd $Q$:

- $A$-Quality($Q, A$)
- $A$-Relation($Q, A$)
- $A$-Quantity($Q, A$)
3.2. Attention maxims

**A-maxims:** For an attentional intent $\mathcal{A}$ and a QUOD $\mathcal{Q}$:

\[
\text{A-Quality}(\mathcal{Q}, \mathcal{A}) = \forall a \ (\mathcal{A}(a) \rightarrow \Diamond \forall a) \quad \text{(first attempt)}
\]

\[
\text{A-Relation}(\mathcal{Q}, \mathcal{A})
\]

\[
\text{A-Quantity}(\mathcal{Q}, \mathcal{A})
\]

Alternative, equivalent formulation of A-Quantity:

\[
\text{A-Quantity}(\mathcal{Q}, \mathcal{A}) = \forall a \ ((\mathcal{Q}(a) \land \neg \mathcal{A}(a)) \rightarrow \neg \Diamond \forall a)
\]

Not quite right, e.g.:

(13) Who (of John, Mary and Bill) was at the party?
  c. John, or everyone.
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\text{A-Quality}(Q, A) = \forall a \,(A(a) \rightarrow \Box \neg a) \quad \text{(first attempt)}
\]
\[
\text{A-Relation}(Q, A) = \forall a \,(A(a) \rightarrow Q(a))
\]
\[
\text{A-Quantity}(Q, A)
\]
3.2. Attention maxims

**A-maxims:** For an attentional intent $A$ and a QUUD $Q$:

\[
A\text{-}\text{Quality}(Q, A) = \forall a (A(a) \rightarrow \diamond \, ^\wedge a) \quad \text{(first attempt)}
\]

\[
A\text{-}\text{Relation}(Q, A) = \forall a (A(a) \rightarrow Q(a))
\]

\[
A\text{-}\text{Quantity}(Q, A) = \forall a \left( \left( A\text{-}\text{Quality}(\{a\}) \land A\text{-}\text{Relation}(Q, \{a\}) \right) \rightarrow A(a) \right)
\]
3.2. Attention maxims

**A-maxims:** For an attentional intent $\mathcal{A}$ and a QUAD $Q$:

\[
\text{A-Quality}(Q, \mathcal{A}) = \forall a \left( \mathcal{A}(a) \rightarrow \Diamond \vee a \right) \quad \text{(first attempt)}
\]

\[
\text{A-Relation}(Q, \mathcal{A}) = \forall a \left( \mathcal{A}(a) \rightarrow Q(a) \right)
\]

\[
\text{A-Quantity}(Q, \mathcal{A}) = \forall a \left( \left( \text{A-Quality}\{a\} \wedge \text{A-Relation}(Q, \{a\}) \right) \rightarrow \mathcal{A}(a) \right)
\]

Alternative, equivalent formulation of A-Quantity:

\[
\text{A-Quantity}(Q, \mathcal{A}) = \forall a \left( (Q(a) \wedge \neg \mathcal{A}(a)) \rightarrow \neg \Diamond \vee a \right)
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3.2. Attention maxims

**A-maxims:** For an attentional intent $A$ and a QUd $Q$:

1. **A-Quality** ($Q, A$) = $\forall a (A(a) \rightarrow \Diamond \forall a)$
   
2. **A-Relation** ($Q, A$) = $\forall a (A(a) \rightarrow Q(a))$

3. **A-Quantity** ($Q, A$) = $\forall a \left( \left( A-Quality(\{a\}) \land A-Relation(Q, \{a\}) \right) \rightarrow A(a) \right)$

Alternative, equivalent formulation of A-Quantity:

$$A-Quantity(Q, A) = \forall a \left( (Q(a) \land \neg A(a)) \rightarrow \square \neg \forall a \right)$$
3.2. Attention maxims

**A-maxims**: For an attentional intent $\mathcal{A}$ and a QUd $\mathcal{Q}$:

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\text{A-Quality}(\mathcal{Q}, \mathcal{A}) &= \forall a \left( \mathcal{A}(a) \rightarrow \Diamond \forall a \right) \\
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(13) Who (of John, Mary and Bill) was at the party?

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- **A-Quality** $(Q, A) = \forall a (A(a) \rightarrow \diamond \uparrow a)$
- **A-Relation** $(Q, A) = \forall a (\neg A(a) \rightarrow Q(a))$
- **A-Quantity** $(Q, A) = \forall a \left( \left( \begin{array}{c} \text{A-Quality}\{a\} \land \\ \text{A-Relation}(Q, \{a\}) \end{array} \right) \rightarrow A(a) \right)$

Alternative, equivalent formulation of **A-Quantity**:

- **A-Quantity** $(Q, A) = \forall a \left( (Q(a) \land \neg A(a)) \rightarrow \Box \neg \uparrow a \right)$

Not quite right, e.g.:

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3.2. Attention maxims

**A-maxims:** For an attentional intent \( A \) and a **QUD** \( Q \):

\[
A\text{-Quality}(Q, A) = \forall a (A(a) \rightarrow \Diamond (\bigvee a))
\]

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A\text{-Quantity}(Q, A) = \forall a \left( \left( A\text{-Quality}(\{a\}) \land A\text{-Relation}(Q, \{a\}) \right) \rightarrow A(a) \right)
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- **A-Quality ($Q, \mathcal{A}$):**
  \[
  \forall a \left( \mathcal{A}(a) \rightarrow \Diamond (\forall a \land \forall b \ ((Q(b) \land b \subset a) \rightarrow \neg \forall b)) \right)
  \]

- **A-Relation ($Q, \mathcal{A}$):**
  \[
  \forall a \left( \mathcal{A}(a) \rightarrow Q(a) \right)
  \]

- **A-Quantity ($Q, \mathcal{A}$):**
  \[
  \forall a \left( \left( \mathcal{A}-\text{Quality}(\{a\}) \land \mathcal{A}-\text{Relation}(Q, \{a\}) \right) \rightarrow \mathcal{A}(a) \right)
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  \]

- **A-Relation** ($Q, A$)
  \[
  A\text{-Relation}(Q, A) = \forall a \left( A(a) \rightarrow Q(a) \right)
  \]

- **A-Quantity** ($Q, A$)
  \[
  A\text{-Quantity}(Q, A) = \forall a \left( \left( A\text{-Quality} \left( \left\{ a \right\} \right) \land A\text{-Relation}(Q, \left\{ a \right\}) \right) \rightarrow A(a) \right)
  \]

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\end{align*}
\]

Alternative, equivalent formulation of A-Quantity:

\[
\text{A-Quantity}(Q, \mathcal{A}) = \forall a \left( \left( Q(a) \land \neg \mathcal{A}(a) \right) \rightarrow \Box \left( \neg \Diamond a \lor \exists b \left( \mathcal{A}(b) \land (b \subset a) \land \Diamond b \right) \right) \right)
\]

Not quite right, e.g.:

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Alternative, equivalent formulation of A-Quantity:

\[
A\text{-Quantity}(Q, A) = \forall a \left( \left( Q(a) \land \neg A(a) \right) \rightarrow \Box \left( \neg \forall a \lor \exists b (A(b) \land (b \subset a) \land \lor b) \right) \right)
\]

Better:

(13) Who (of John, Mary and Bill) was at the party?

  c. John, or everyone. \hspace{1cm} (Exh.: if Mary/Bill, then everyone.)
3.3. Illustration of A-maxims

(13)  a. John.  (Exh.: not Mary or Bill.)
   b. John, or both John and Mary. (Exh.: not Bill.)
   c. John, or everyone. (Exh.: if Mary/Bill, then everyone.)
3.3. Illustration of A-maxims

(13) a. John. (Exh.: not Mary or Bill.)
   b. John, or both John and Mary. (Exh.: not Bill.)
   c. John, or everyone. (Exh.: if Mary/Bill, then everyone.)

Let \( Q = \{^P j, ^P m, ^P b, \ldots\} \) (closed under intersection)
3.3. Illustration of A-maxims

(13) a. John. \((Exh.:\ not\ Mary\ or\ Bill.\)\)
b. John, or both John and Mary. \((Exh.:\ not\ Bill.\)\)
c. John, or everyone. \((Exh.:\ if\ Mary/Bill,\ then\ everyone.\)\)

Let \(Q = \{\wedge P_j, \wedge P_m, \wedge P_b, \ldots\}\) (closed under intersection)
3.3. Illustration of A-maxims

(13) a. John. (Exh.: not Mary or Bill.)
    b. John, or both John and Mary. (Exh.: not Bill.)
    c. John, or everyone. (Exh.: if Mary/Bill, then everyone.)

Let $Q = \{^\wedge P_j, ^\wedge P_m, ^\wedge P_b, \ldots \}$ (closed under intersection), and:

- (13a): $A = \{^\wedge P_j\}$;
3.3. Illustration of A-maxims

(13) a. John. \hspace{1cm} (Exh.: not Mary or Bill.)

b. John, or both John and Mary. \hspace{1cm} (Exh.: not Bill.)

c. John, or everyone. \hspace{1cm} (Exh.: if Mary/Bill, then everyone.)

Let \( Q = \{ \wedge P_j, \wedge P_m, \wedge P_b, \ldots \} \) (closed under intersection)

- (13a): \( A = \{ \wedge P_j \}; \)
- (13b): \( A = \{ \wedge P_j, \wedge (P_j \wedge P_m) \}; \)
3.3. Illustration of $A$-maxims

(13) a. John. (Exh.: not Mary or Bill.)
   b. John, or both John and Mary. (Exh.: not Bill.)
   c. John, or everyone. (Exh.: if Mary/Bill, then everyone.)

Let $Q = \{^\wedge Pj, ^\wedge Pm, ^\wedge Pb, \ldots\}$ (closed under intersection)

- (13a): $A = \{^\wedge Pj\}$;
- (13b): $A = \{^\wedge Pj, (^\wedge Pj \land ^\wedge Pm)\}$;
- (13c): $A = \{^\wedge Pj, (^\wedge Pj \land ^\wedge Pm \land ^\wedge Pb)\}$. 
3.3. Illustration of A-maxims

(13) a. John. \(\text{(Exh.: not Mary or Bill.)}\)
    b. John, or both John and Mary. \(\text{(Exh.: not Bill.)}\)
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Let \(Q = \{ \land P_j, \land P_m, \land P_b, \ldots \}\) (closed under intersection)

- (13a): \(A = \{ \land P_j \}\);
- (13b): \(A = \{ \land P_j, (P_j \land P_m) \}\);
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- (13a): \( A = \{ \wedge P_j \}; \)
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- (13a): \( A = \{\land Pj\}; \)
- (13b): \( A = \{\land Pj, (Pj \land Pm)\}; \)
- (13c): \( A = \{\land Pj, (Pj \land Pm \land Pb)\}. \)
3.4. An exhaustivity "operator"

Repeated:

\[
\text{A-Quantity}(Q, A) = \forall a \left( (Q(a) \land \neg A(a)) \rightarrow \right. \\
\left. \square \left( \neg \lor a \lor \exists b (A(b) \land (b \subset a) \land \lor b ) \right) \right)
\]
3.4. An exhaustivity “operator”

Repeated:

\[
\text{A-Quantity}(Q, A) = \forall a \left( (Q(a) \land \neg A(a)) \rightarrow \Box \left( \neg \forall a \lor \exists b (A(b) \land (b \subset a) \land \forall b) \right) \right)
\]
3.4. An exhaustivity “operator”

Repeated:

\[
A\text{-Quantity}(Q,A) = \forall a \left( (Q(a) \land \lnot A(a)) \rightarrow \Box \left( \neg \forall a \lor \exists b (A(b) \land (b \subset a) \land \forall b) \right) \right)
\]

A convenient shorthand:

\[
\text{Exh}(Q,A) = \forall a \left( (Q(a) \land \lnot A(a)) \rightarrow \neg \forall a \lor \exists b (A(b) \land (b \subset a) \land \forall b) \right)
\]
3.4. An exhaustivity “operator”

Repeated:

\[
\text{A-Quantity}(Q, A) = \forall a \left( (Q(a) \land \neg A(a)) \rightarrow \Box \left( \neg \forall a \lor \exists b (A(b) \land (b \subset a) \land \forall b) \right) \right)
\]

A convenient shorthand:

\[
\text{Exh}(Q, A) = \forall a \left( (Q(a) \land \neg A(a)) \rightarrow (\neg \forall a \lor \exists b (A(b) \land (b \subset a) \land \forall b)) \right)
\]
3.4. An exhaustivity “operator”

Repeated:

\[ \text{A-Quantity}(Q, A) = \forall a \left( (Q(a) \land \neg A(a)) \rightarrow \square \left( \neg \lor a \lor \exists b (A(b) \land (b \subset a) \land \lor b) \right) \right) \]

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\]

Alternative, equivalent definition:

\[
\text{Exh}(Q, A) = \bigcap_{a \in Q} (\overline{a} \cup \bigcup_{b \in A} b)
\]

\[
\bigcap_{a \notin A} \bigcup_{b \subset a} b
\]
3.5. Comparison to standard “minimal worlds” operator

The basic idea (Van Rooij & Schulz 2006; Spector 2007):

▶ remove all worlds from the informational intent...
▶ in which the set of relevant true propositions isn’t minimal.
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The basic idea (Van Rooij & Schulz 2006; Spector 2007):
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\[
\left[ \text{ExH}_{\text{mw}}(p, Q) \right] = \{ w \in [p] \mid \text{there is no } w' \in [p] \text{ such that:} \\
\{ W' \in [Q] \mid w' \in W' \} \subset \{ W' \in [Q] \mid w \in W' \} \}
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\]

**Fact.** For any admissible model \( M \) where \( A = \{ p \} \), and these intents can comply with the maxims relative to \( Q \): \( M \models \text{Exh}_{mw}(p, Q) = p \cap \text{Exh}(A, Q) \).
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\]

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\( M \models \text{Exh}_{mw}(p, Q) = p \cap \text{Exh}(A, Q) \)

Thus:

▶ if attention doesn’t really matter, my \( \text{Exh} \) is conservative;
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\[
\text{E}_{\text{ExH}_{\text{mw}}}(p, Q) = \{ w \in [p] | \text{there is no } w' \in [p] \text{ such that:} \\
\{ W' \in [Q] | w' \in W' \} \subset \{ W' \in [Q] | w \in W' \} \}\]

Fact. For any admissible model \( M \) where \( A = \{ p \} \), and these intents can comply with the maxims relative to \( Q \):
\[
M \models \text{E}_{\text{ExH}_{\text{mw}}}(p, Q) = p \cap \text{E}_{\text{ExH}}(A, Q)
\]

Thus:
▶ if attention doesn’t really matter, my \( \text{E}_{\text{ExH}} \) is conservative;
▶ though only as a purely technical device;
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The basic idea (Van Rooij & Schulz 2006; Spector 2007):
▶ remove all worlds from the informational intent...
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\[ \lbrack \text{Exh}_{\text{mw}}(p, Q) \rbrack = \{ w \in \llbracket p \rrbracket \mid \text{there is no } w' \in \llbracket p \rrbracket \text{ such that:} \]
\[ \{ W' \in \llbracket Q \rrbracket \mid w' \in W' \} \subset \{ W' \in \llbracket Q \rrbracket \mid w \in W' \} \}\]

Fact. For any admissible model \( M \) where \( A = \{ p \} \), and these intents can comply with the maxims relative to \( Q \):

\[ M \models \text{Exh}_{\text{mw}}(p, Q) = p \cap \text{Exh}(A, Q) \]

Thus:
▶ if attention doesn’t really matter, my \( \text{Exh} \) is conservative;
▶ though only as a purely technical device;
▶ my account makes very different predictions (e.g., problems A, B, D.
3.6. Comparison to “dynamic” operator

The basic idea (Van Rooij and Schulz 2006):

- like $\text{ExH}_{mw}$, but minimize only among world-assignment pairs that share the same assignment;

\[
[\text{ExH}_{\text{dyn}}(A, Q)] = \{ w \mid \text{for some } W' \in [A], w \in W' \text{ and there is no } w' \in W' \text{ s.t. } W' \subseteq [Q] \}
\]

For any admissible model $M$ s.t. $p = \bigcup A$, $Q$ is closed under inters., and $p$ and $A$ can comply with the maxims relative to $Q$:

\[
M | = \text{ExH}_{\text{dyn}}(A, Q) = (p \cap \text{ExH}(A, Q))
\]

As technical devices our operators are very close, but again:

- explanatorily our accounts are very different; and empirically they make very different predictions.
3.6. Comparison to “dynamic” operator

The basic idea (Van Rooij and Schulz 2006):

- like $\text{Exh}_{mw}$, but minimize only among world-assignment pairs that share the same assignment;
- not derived from a pragmatic theory.

Simplifying somewhat:

$$\text{Exh}_{\text{dyn}}(A, Q) = \{ w | \text{for some } W' \in \{ A \} : w \in W' \text{ and there is no } w' \in W' \text{ s.t. } \{ W' \in \{ Q \} | w' \in W' \} \subset \{ W' \in \{ Q \} | w \in W' \} \}$$

For any admissible model $M$ s.t. $p = \bigcup A$, $Q$ is closed under inters., and $p$ and $A$ can comply with the maxims relative to $Q$:

$$M|_t = \text{Exh}_{\text{dyn}}(A, Q) = (p \cap \text{Exh}(A, Q))$$

As technical devices our operators are very close, but again:

- explanatorily our accounts are very different;
- and empirically they make very different predictions.
3.6. Comparison to “dynamic” operator

The basic idea (Van Rooij and Schulz 2006):

- like $\text{ExH}_{mw}$, but minimize only among world-assignment pairs *that share the same assignment*;
- *not* derived from a pragmatic theory.

Simplifying somewhat:

$$\mathbb{E}xH_{\text{dy}n}(A, Q) = \{ w \mid \text{for some } W' \in \llbracket A \rrbracket: w \in W' \text{ and there is no } w' \in W' \text{ s.t. } \{ W' \in \llbracket Q \rrbracket \mid w' \in W' \} \subset \{ W' \in \llbracket Q \rrbracket \mid w \in W' \} \}$$
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Simplifying somewhat:

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For any admissible model $M$ s.t. $p = \bigcup A$, $Q$ is closed under inters., and $p$ and $A$ can comply with the maxims relative to $Q$: $M \models \text{Exh}_{\text{dyn}}(A, Q) = (p \cap \text{Exh}(A, Q))$
3.6. Comparison to “dynamic” operator

The basic idea (Van Rooij and Schulz 2006):

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Simplifying somewhat:

$$\left[\text{ExH}_{\text{dyn}}(A, Q)\right] = \{w | \text{for some } W' \in \left[\left[ A \right]\right]: w \in W' \text{ and there is no } w' \in W' \text{ s.t. } \{W' \in \left[\left[ Q \right]\right] | w' \in W'\} \subset \{W' \in \left[\left[ Q \right]\right] | w \in W'\}\}$$

For any admissible model $M$ s.t. $p = \bigcup A$, $Q$ is closed under inters., and $p$ and $A$ can comply with the maxims relative to $Q$: $M \models \text{ExH}_{\text{dyn}}(A, Q) = (p \cap \text{ExH}(A, Q))$

As technical devices our operators are very close, but again:

- explanatorily our accounts are very different;
- and empirically they make very different predictions.
Outline

1. “Destructive” problems (A,B,C)

2. “Constructive” problems (D,E)

3. Formal, attention-based account

4. Discussion
4.1. Conclusion

The standard recipe was wrong.
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But an alternative pragmatic account is available:
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But an alternative pragmatic account is available:

- speakers intentionally share attention;
4.1. Conclusion

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- governed by the A-maxims;
4.1. Conclusion

The standard recipe was wrong.

But an alternative pragmatic account is available:

- speakers intentionally share attention;
- governed by the A-maxims;
- exhaustivity derives from A-Quantity:
  - “intend to draw attention to all relevant propositions that you consider possible independently of anything stronger to which you intend to draw attention.”
4.1. Conclusion

The standard recipe was wrong.

But an alternative pragmatic account is available:

- speakers intentionally share attention;
- governed by the A-maxims;
- exhaustivity derives from A-Quantity:
  - “intend to draw attention to all relevant propositions that you consider possible independently of anything stronger to which you intend to draw attention.”
- the predicted implications are technically similar to the patterns described by (some) existing operators.
4.2. Is this what rationality looks like?

\[
\begin{align*}
\text{I-Quality}(p) &= \Box \lor p \\
\text{I-Relation}(Q, p) &= Q(p) \\
\text{I-Quantity}(Q, p) &= \forall q \left( \left( \text{I-Quality}(q) \land \text{I-Relation}(Q, q) \right) \rightarrow (p \subseteq q) \right)
\end{align*}
\]

\[
\begin{align*}
\text{A-Quality}(Q, A) &= \forall a \left( A(a) \rightarrow \lozenge (\lor a \land \forall b ((Q(b) \land b \subset a) \rightarrow \neg \lor b)) \right) \\
\text{A-Relation}(Q, A) &= \forall a (A(a) \rightarrow Q(a)) \\
\text{A-Quantity}(Q, A) &= \forall a \left( \left( \text{A-Quality}\{a\} \land \text{A-Relation}(Q, \{a\}) \right) \rightarrow A(a) \right)
\end{align*}
\]
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