Attention, exhaustivity and non-cooperativity

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Two puzzles

(1) Of John, Bill and Mary, who came to the party?
   a. John came ↘.  ~ Mary and Bill didn’t.
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(1) Of John, Bill and Mary, who came to the party?
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Two puzzles

(1) Of John, Bill and Mary, who came to the party?
   a. John came ↘.  ~ Mary and Bill didn’t.
   b. John came ↗.
Two puzzles

(1) Of John, Bill and Mary, who came to the party?
a. John came \( \downarrow \). \( \sim \) Mary and Bill didn’t.
b. John came \( \uparrow \).
\( \sim \) ...wait, there’s more.
Two puzzles

(1) Of John, Bill and Mary, who came to the party?
   a. John came ↓. ~ Mary and Bill didn’t.
   b. John came ↑.
      ~ ...wait, there’s more.
      ~ ...perhaps that implies sth. about M&B?
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   a. John came ↓.  → Mary and Bill didn’t.
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      → ...did I make myself clear?
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   a. John came ↓. .getTag(“Mary and Bill didn’t.
   b. John came ↑.
      ~  ...wait, there’s more.
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      ~  ...did I make myself clear?

De Morgan, 1847
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   a. John came \(\downarrow\).  \(\sim\) Mary and Bill didn’t.
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      \(\sim\) ...but I’m not sure.
      \(\sim\) ...did I make myself clear?

‘In common conversation the confirmation of a part is meant to imply the denial of the remainder.’

(De Morgan, 1847)
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(1) Of John, Bill and Mary, who came to the party?
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Part I

1. Diagnosis
2. Theory
3. Results
4. Discussion
1. Diagnosis

1.1. The problem
1.2. Existing approaches
1.3. Towards a solution
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(1) Of John, Bill and Mary, who came to the party?
   a. John came. $\sim$ Mary and Bill didn’t. (exhaustivity)
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(1) Of John, Bill and Mary, who came to the party?
   a. John came\(\Rightarrow\)   \(\sim\) Mary and Bill didn’t. (exhaustivity)

Conversational implicature (Grice, 1975)
An implicature, the supposition of which is necessary for maintaining the assumption that the speaker is cooperative.
1.1. The problem

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1. Had sp. believed Mary or Bill came, she should have said so.
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3. She believes that they didn’t come.
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   a. John came \( \rightarrow \) Mary and Bill didn’t. \( \text{(exhaustivity)} \)

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1. Had sp. believed Mary or Bill came, she should have said so.
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   \( \ldots \) (‘the epistemic step’ - Sauerland, 2004)
3. She believes that they didn’t come.
1.1. The problem

(1) Of John, Bill and Mary, who came to the party?
   a. John came. \(\Rightarrow\) \(\neg\) Mary and Bill didn’t. \((\text{exhaustivity})\)

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1. Had sp. believed Mary or Bill came, she should have said so.
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3. She believes that they didn’t come.

"[the epistemic] step does not follow from Gricean maxims and logic alone." - Chierchia, et al. (2008)
1.1. The problem

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   a. John came \( \downarrow \). \( \sim \) Mary and Bill didn’t. (exhaustivity)

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3. She believes that they didn’t come.

“[the epistemic] step does not follow from Gricean maxims and logic alone.” - Chierchia, et al. (2008)

Wrong, it does!
1.2. Existing approaches

Most existing work (going back to Mill, 1867):

- The speaker lacks the belief that Mary came (Quantity)
- She is opinionated about whether Mary came (Context)
- She believes that Mary didn’t come

What warrants the opinionatedness assumption?

It is empirically inadequate:

(5) I’m asking the wrong person, but who came to the party?

John and Bill came.

Opinionatedness must be something conveyed by the speaker.
1.2. Existing approaches

Most existing work (going back to Mill, 1867):

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(5) I'm asking the wrong person, but who came to the party? John and Bill came. Mary didn't.

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Most existing work (going back to Mill, 1867):

1. The speaker lacks the belief that Mary came

2. She is *opinionated* about whether Mary came

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   ▪ What warrants the opinionatedness assumption?
   ▪ It is empirically inadequate:

(5) I’m asking the wrong person, but who came to the party? John and Bill came. ~ Not Mary.
1.2. Existing approaches

Most existing work (going back to Mill, 1867):

1. The speaker lacks the belief that Mary came (Quantity)
2. She is *opinionated* about whether Mary came (Context)
3. She believes that Mary didn’t come

- What warrants the opinionatedness assumption?
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(5) I’m asking the wrong person, but who came to the party? John and Bill came. \(\sim\) Not Mary.

- Opinionatedness must be something *conveyed by the speaker.*
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- What warrants the opinionatedness assumption?
- It is empirically inadequate:

(5) I’m asking the wrong person, but who came to the party?  
    John and Bill came.  ¬ Not Mary.

- Opinionatedness must be something *conveyed by the speaker*.
1.3. Towards a solution

(2) a. Of John, Bill and Mary, who came to the party?
   b. John came.  \(\sim\) Mary didn’t come
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(2) a. Of John, Bill and Mary, who came to the party?
    b. John came. ~ Mary didn’t come
    c. John came, or Mary and John. ~ Mary didn’t come
1.3. Towards a solution

(2) a. Of John, Bill and Mary, who came to the party?
    b. John came.  \sim Mary didn’t come
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Intuition
(2b) and (2c) differ in their *attentive content*.
1.3. Towards a solution

(2) a. Of John, Bill and Mary, who came to the party?
   b. John came. ¬ Mary didn’t come
   c. John came, or Mary and John. ⊤ Mary didn’t come

Intuition
(2b) and (2c) differ in their attentive content.

• (2c) draws attention to the poss. that Mary came too.
1.3. Towards a solution

(2) a. Of John, Bill and Mary, who came to the party?
   b. John came. ~ Mary didn’t come
   c. John came, or Mary and John. ℽ Mary didn’t come

Intuition
(2b) and (2c) differ in their attentive content.
   ▶ (2c) draws attention to the poss. that Mary came too.
   ▶ (And so does (2a).)
1.3. Towards a solution

(2) a. Of John, Bill and Mary, who came to the party?
    b. John came. \( \sim \) Mary didn’t come
    c. John came, or Mary and John. \( \not\sim \) Mary didn’t come

Intuition
(2b) and (2c) differ in their *attentive content*.

- (2c) draws attention to the poss. that Mary came too.
- (And so does (2a).)
- (2b) doesn’t; it leaves the possibility *unattended*.
1.3. Towards a solution

(2) a. Of John, Bill and Mary, who came to the party?        \[\text{Mary didn’t come}\]
    b. John came.                        \[\sim\text{Mary didn’t come}\]
    c. John came, or Mary and John.      \[\not\sim\text{Mary didn’t come}\]

Intuition
(2b) and (2c) differ in their \textit{attentive content}.

\begin{itemize}
  \item (2c) draws attention to the poss. that Mary came too.
  \item (And so does (2a).)
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\end{itemize}

Apparentely, pragmatic reasoning is sensitive to this.
1.3. Towards a solution

(2) a. Of John, Bill and Mary, who came to the party?
   b. John came.                   $\sim$ Mary didn’t come
   c. John came, or Mary and John. $\not\sim$ Mary didn’t come

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- (2c) draws attention to the poss. that Mary came too.
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(2) a. Of John, Bill and Mary, who came to the party?
   b. John came. ~ Mary didn’t come
   c. John came, or Mary and John. ~ Mary didn’t come

Intuition

(2b) and (2c) differ in their *attentive content*.

- (2c) draws attention to the poss. that Mary came too.
- (And so does (2a).)
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(2) a. Of John, Bill and Mary, who came to the party?
   b. John came.  \sim \text{Mary didn’t come}
   c. John came, or Mary and John.  \not\sim \text{Mary didn’t come}

Intuition
(2b) and (2c) differ in their attentive content.
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(2) a. Of John, Bill and Mary, who came to the party?
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2. Theory

2.1. Translation into logic
2.2. Semantics
2.3. Pragmatics
2.1. Translation into logic

(3) a. Of John, Bill and Mary, who came to the party?
   b. John came.  \( \sim \) Mary didn’t come
   c. John came, or Mary and John.  \( \not\sim \) Mary didn’t come
(3) a. Of John and Mary, who came to the party?
   b. John came.  \[ \sim \text{Mary didn’t come} \]
   c. John came, or Mary and John.  \[ \lor \text{Mary didn’t come} \]
2.1. Translation into logic

(3) a. Of John and Mary, some came to the party.
   b. John came.  \( \sim \) Mary didn’t come
   c. John came, or Mary and John.  \( \not\) Mary didn’t come
2.1. Translation into logic

(3) a. John came, or Mary, or John and Mary.
   b. John came.  \[\sim \text{Mary didn’t come}\]
   c. John came, or Mary and John.  \[\lnot \text{Mary didn’t come}\]
2.1. Translation into logic

(3) a. John came, or Mary, or John and Mary.
b. John came.
c. John came, or Mary and John.
2.1. Translation into logic

(3) a. John came, or Mary, or John and Mary. \[ p \lor q \lor (p \land q) \]
   b. John came. \[ p \]
   c. John came, or Mary and John. \[ p \lor (p \land q) \]
2.2. Semantics (Roelofsen, 2011)

\begin{align*}
\neg\neg \neg\neg & \vdash (p \land q) \\
\neg\neg \neg\neg & \vdash p \lor q
\end{align*}

Possibility: a set of worlds \((a, b)\)

Proposition: a set of possibilities \((A, B, \{\phi\})\)

Informative content: \(\phi \div \phi \equiv \exists \)

Entailment \(A \implies B\), iff (i) \(A \subseteq B\); and (ii) for all \(b \in B\), if \(b \cap \exists A \neq \emptyset\), then \(b \cap \exists A \in A\).
2.2. Semantics (Roelofsen, 2011)

- *Possibility*: a set of worlds \((a, b)\)
2.2. Semantics (Roelofsen, 2011)

- **Possibility**: a set of worlds \((a, b)\)
- **Proposition**: a set of possibilities \((A, B, [\varphi])\)
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- **Possibility**: a set of worlds \((a, b)\)
- **Proposition**: a set of possibilities \((A, B, [\varphi])\)
- **Informative content**: \(|\varphi| := \bigcup[\varphi]\)
2.2. Semantics (Roelofsen, 2011)

- *Possibility*: a set of worlds \((a, b)\)
- *Proposition*: a set of possibilities \((A, B, [\varphi])\)
- *Informative content*: \(|\varphi| := \bigcup[\varphi]\)

\[(3a) \ [p \lor q \lor (p \land q)] \quad (3b) \ [p] \quad (3c) \ [p \lor (p \land q)]\]
2.2. Semantics (Roelofsen, 2011)

- *Possibility*: a set of worlds \((a, b)\)
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\begin{align*}
(3a) & \quad [p \lor q \lor (p \land q)] \\
(3b) & \quad [p] \\
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\[(3a) \quad [p \lor q \lor (p \land q)]\]
\[(3b) \quad [p]\]
\[(3c) \quad [p \lor (p \land q)]\]

**Entailment**

\(A \text{ entails } B, A \models B, \) iff

\(i\) \(\bigcup A \subseteq \bigcup B\); and

\(ii\) for all \(b \in B\), if \(b \cap \bigcup A \neq \emptyset\), \(b \cap \bigcup A \in A\)
2.2. Semantics (Roelofsen, 2011)

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\( A \) entails \( B \), \( A \models B \), iff

(i) \( \bigcup A \subseteq \bigcup B \); and

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\(\rightarrow\) at least as informative
2.2. Semantics (Roelofsen, 2011)

- *Possibility*: a set of worlds \((a, b)\)
- *Proposition*: a set of possibilities \((A, B, [\varphi])\)
- *Informative content*: \(|\varphi| := \bigcup [\varphi]\)

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(3a) \ [p \lor q \lor (p \land q)]
\]

\[
(3b) \ [p]
\]

\[
(3c) \ [p \lor (p \land q)]
\]

**Entailment**

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(i) \(\bigcup A \subseteq \bigcup B\); and

(ii) for all \(b \in B\), if \(b \cap \bigcup A \neq \emptyset\), \(b \cap \bigcup A \in A\)

\[\rightarrow\text{at least as informative}\]

\[\rightarrow\text{at least as attentive}\]
2.2. Semantics (Roelofsen, 2011)

- **Possibility**: a set of worlds \((a, b)\)
- **Proposition**: a set of possibilities \((A, B, [\varphi])\)
- **Informative content**: \(|\varphi| := \bigcup [\varphi] \)

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\begin{align*}
(3a) \quad [p \lor q \lor (p \land q)] \\
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**Entailment**

\(A \text{ entails } B, A \models B, \) iff

(i) \( \bigcup A \subseteq \bigcup B; \) and

(ii) for all \( b \in B, \) if \( b \cap \bigcup A \neq \emptyset, \) \( b \cap \bigcup A \in A \)

Now, \((3c) \models (3a), \) but \((3b) \not\models (3a).\)
2.3. Pragmatics

The relevant maxims

1. Quality:
2. Quantity:
3. Relation:
2.3. Pragmatics

The relevant maxims
For a cooperative speaker with information $s$, responding $R$ to $Q$:

1. **Quality:**
2. **Quantity:**
3. **Relation:**

(4) Did John go to the party? It was raining. If it rained, John {went / didn't go}.
2.3. Pragmatics

The relevant maxims
For a cooperative speaker with information $s$, responding $R$ to $Q$:

1. **Quality**: $s \subseteq \bigcup R$.
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The relevant maxims

For a cooperative speaker with information $s$, responding $R$ to $Q$:

1. **Quality**: $s \subseteq \bigcup R$.
2. **Quantity**: For all $Q' \subseteq Q$, if $s \subseteq \bigcup Q'$ then $\bigcup R \subseteq \bigcup Q'$.
3. **Relation**:
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The relevant maxims

For a cooperative speaker with information $s$, responding $R$ to $Q$:

1. **Quality**: $s \subseteq \bigcup R$.
2. **Quantity**: For all $Q' \subseteq Q$, if $s \subseteq \bigcup Q'$ then $\bigcup R \subseteq \bigcup Q'$.
3. **Relation**: $\{ r \cap s \mid r \in R \} \models Q$. 

(4) Did John go to the party?

It was raining.

If it rained, John \{went / didn’t go\}. 


The relevant maxims
For a cooperative speaker with information $s$, responding $R$ to $Q$:

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For a cooperative speaker with information \( s \), responding \( R \) to \( Q \):

1. **Quality**: \( s \subseteq \bigcup R \).
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For a cooperative speaker with information \( s \), responding \( R \) to \( Q \):

1. **Quality**: \( s \subseteq \bigcup R \).
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3. **Relation**: \( \{ r \cap s \mid r \in R \} \models Q \).

(4) Did John go to the party?
It was raining.

\[
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\end{align*}
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For a cooperative speaker with information $s$, responding $R$ to $Q$:

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(4) Did John go to the party?
It was raining.
The relevant maxims

For a cooperative speaker with information $s$, responding $R$ to $Q$:

1. **Quality**: $s \subseteq \cup R$.
2. **Quantity**: For all $Q' \subseteq Q$, if $s \subseteq \cup Q'$ then $\cup R \subseteq \cup Q'$.
3. **Relation**: $\{ r \cap s \mid r \in R \} \models Q$.

(4) Did John go to the party?
   It was raining.
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For a cooperative speaker with information $s$, responding $R$ to $Q$:

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(4) Did John go to the party?
It was raining. $\sim$ If it rained, John $\{\text{went} / \text{didn’t go}\}$. 

\[
\begin{array}{c}
\{\text{rp} \cap s \mid \text{rp} \in R\} = \models \bigcup \{\text{rp} \mid \text{rp} \in R\}
\end{array}
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The relevant maxims
For a cooperative speaker with information $s$, responding $R$ to $Q$:

1. **Quality**: $s \subseteq \bigcup R$.
2. **Quantity**: For all $Q' \subseteq Q$, if $s \subseteq \bigcup Q'$ then $\bigcup R \subseteq \bigcup Q'$.
3. **Relation**: $\{r \cap s \mid r \in R\} \models Q$.

(4) Did John go to the party? It was raining.

If it rained, John {went / didn’t go}. 
3. Results

3.1. Examples

3.2. Formal results

3.3. And more conceptually…
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

   b. John came. \((p)\)

   c. John came, or Mary and John. \((p \lor (p \land q))\)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)

c. John came, or Mary and John. \((p \lor (p \land q))\)

1. \(s \subseteq |p \lor (p \land q)|\) 

(Quality)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)

c. John came, or Mary and John. \((p \lor (p \land q))\)

1. \(s \subseteq |p \lor (p \land q)| = |p|\) (Quality)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)

c. John came, or Mary and John. \((p \lor (p \land q))\)
   1. \(s \subseteq |p \lor (p \land q)| = |p|\)  \hspace{1cm} (Quality)
   2. \(s \not\subseteq |q|\)  \hspace{1cm} (Quantity)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)

c. John came, or Mary and John. \((p \lor (p \land q))\)

1. \(s \subseteq |p \lor (p \land q)| = |p|\) (Quality)
2. \(s \not\subseteq |q|\) (Quantity)

\(p \lor (p \land q) \supseteq p \lor q \lor (p \land q)\)
3.1. Examples

\( (3) \) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)

c. John came, or Mary and John. \((p \lor (p \land q))\)

1. \(s \subseteq |p \lor (p \land q)| = |p|\) \hspace{8cm} \text{(Quality)}
2. \(s \notin |q|\) \hspace{10cm} \text{(Quantity)}
3. - \hspace{12cm} p \lor (p \land q) \models p \lor q \lor (p \land q) \hspace{8cm} \text{(Relation)}
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)
   1. \(s \subseteq |p|\)  

   (Quality)

   (Quantity)

   (Relation)

   c. John came, or Mary and John. \((p \lor (p \land q))\)
      1. \(s \subseteq |p \lor (p \land q)| = |p|\)
      2. \(s \not\subseteq |q|\)
      3. - \(p \lor (p \land q) \Rightarrow p \lor q \lor (p \land q)\)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)
   1. \(s \subseteq |p|\) \hspace{1cm} \text{(Quality)}
   2. \(s \notin |q|\) \hspace{1cm} \text{(Quantity)}

c. John came, or Mary and John. \((p \lor (p \land q))\)
   1. \(s \subseteq |p \lor (p \land q)| = |p|\) \hspace{1cm} \text{(Quality)}
   2. \(s \notin |q|\) \hspace{1cm} \text{(Quantity)}
   3. \(-\quad p\lor(p\land q) \models p\lor q\lor(p\land q)\) \hspace{1cm} \text{(Relation)}
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)

1. \(s \subseteq |p|\)
2. \(s \not\subseteq |q|\)

\(p \not\rightarrow p \lor q \lor (p \land q)\)  

(Quality)

(Quantity)

c. John came, or Mary and John. \((p \lor (p \land q))\)

1. \(s \subseteq |p \lor (p \land q)| = |p|\)  
2. \(s \not\subseteq |q|\)
3. -  

\(p \lor (p \land q) \not\supseteq p \lor q \lor (p \land q)\)  

(Quality)

(Quantity)

(Relation)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)
   1. \(s \subseteq |p|\)
   2. \(s \not\subseteq |q|\)

\(p \not\subseteq p \lor q \lor (p \land q)\)  
(Quality)  
(Quantity)

c. John came, or Mary and John. \((p \lor (p \land q))\)
   1. \(s \subseteq |p \lor (p \land q)| = |p|\)  
   2. \(s \not\subseteq |q|\)
   3. -  
\(p \lor (p \land q) \supseteq p \lor q \lor (p \land q)\)  
(Quality)  
(Quantity)  
(Relation)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)
   1. \(s \subseteq |p|\)
   2. \(s \notin |q|\)

\(p \nsubseteq p \lor q \lor (p \land q)\)

```
1. s \subseteq |p| = |p|
2. s \notin |q|
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c. John came, or Mary and John. \((p \lor (p \land q))\)

1. \(s \subseteq |p \lor (p \land q)| = |p|\)
2. \(s \notin |q|\)
3. - \(p \lor (p \land q) \nsubseteq p \lor q \lor (p \land q)\)

```
1. s \subseteq |p \lor (p \land q)| = |p|
2. s \notin |q|
3. - p \lor (p \land q) \nsubseteq p \lor q \lor (p \land q)
```
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)
   1. \(s \subseteq |p|\)
   2. \(s \not\subseteq |q|\)

   \(p \not\subseteq p \lor q \lor (p \land q)\)

   \(\text{(Quality)}\)

   \(\text{(Quantity)}\)

\[\begin{array}{ccc}
  & & \\
  & & \\
  & & \\
  & & \\
\end{array} = \begin{array}{ccc}
  & & \\
  & & \\
  & & \\
  & & \\
\end{array} \quad \models \quad \begin{array}{ccc}
  & & \\
  & & \\
  & & \\
  & & \\
\end{array}\]

c. John came, or Mary and John. \((p \lor (p \land q))\)
   1. \(s \subseteq |p \lor (p \land q)| = |p|\)
   2. \(s \not\subseteq |q|\)
   3. \(p \lor (p \land q) \models p \lor q \lor (p \land q)\)

   \(\text{(Quality)}\)

   \(\text{(Quantity)}\)

   \(\text{(Relation)}\)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)
   1. \(s \subseteq |p|\)
   2. \(s \not\subseteq |q|\)

\[p \not\subseteq p \lor q \lor (p \land q)\]  
(Quality)
(Quality)

![Diagram](image)

\[(3) a. John came, Mary came, or both came (p \lor q \lor (p \land q))\]

1. \(s \subseteq |p \lor (p \land q)| = |p|\)
2. \(s \not\subseteq |q|\)
3. \(p \lor (p \land q) \supseteq p \lor q \lor (p \land q)\)
   (Relation)

(c. John came, or Mary and John. \((p \lor (p \land q))\)

1. \(s \subseteq |p \lor (p \land q)| = |p|\)
2. \(s \not\subseteq |q|\)
3. \(p \lor (p \land q) \supseteq p \lor q \lor (p \land q)\)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)

1. \(s \subseteq |p|\)
2. \(s \notin |q|\)

\[ p \quad \text{!!!} \quad p \lor q \lor (p \land q) \]

(Quality)

(Quantity)

\[=\]

\[\vdash\]

\[\quad\]

3. - \(p \lor (p \land q) \vdash p \lor q \lor (p \land q)\)

(Quality)

(Quantity)

(Relation)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)
   1. \(s \subseteq |p|\)
   2. \(s \nsubseteq |q|\) \(p \nsubseteq p \lor q \lor (p \land q)\) (Quality)
   3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup |q|\) (Relation)

c. John came, or Mary and John. \((p \lor (p \land q))\)
   1. \(s \subseteq |p \lor (p \land q)| = |p|\) (Quality)
   2. \(s \nsubseteq |q|\)
   3. \(p \lor (p \land q) \models p \lor q \lor (p \land q)\) (Relation)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)

1. \(s \subseteq |p|\) \hspace{2cm} \(p \not\subseteq p \lor q \lor (p \land q)\) \hspace{2cm} (Quality)
2. \(s \notin |q|\) \hspace{2cm} \(p \subseteq p \lor q \lor (p \land q)\) \hspace{2cm} (Quantity)
3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup |q|\) \hspace{2cm} (Relation)

…

c. John came, or Mary and John. \((p \lor (p \land q))\)

1. \(s \subseteq |p \lor (p \land q)| = |p|\) \hspace{2cm} (Quality)
2. \(s \notin |q|\) \hspace{2cm} \(p \lor (p \land q) \subseteq p \lor q \lor (p \land q)\) \hspace{2cm} (Quantity)
3. - \hspace{2cm} \(p \lor (p \land q) \subseteq p \lor q \lor (p \land q)\) \hspace{2cm} (Relation)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)

1. \(s \subseteq |p|\)
2. \(s \nsubseteq |q|\)
3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup |q|\)

4. \(s \subseteq |q|\)

---

c. John came, or Mary and John. \((p \lor (p \land q))\)

1. \(s \subseteq |p \lor (p \land q)| = |p|\)
2. \(s \nsubseteq |q|\)
3. \(- (p \lor (p \land q)) \iff p \lor q \lor (p \land q)\)
3.1. Examples

(3) a. John came, Mary came, or both came \((p \lor q \lor (p \land q))\)

b. John came. \((p)\)
1. \(s \subseteq |p|\)
2. \(s \not\subseteq |q|\)
3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup |q|\)
   
   \[\begin{array}{c}
   \text{exhaustivity!}
   \end{array}\]

4. \(s \subseteq |q|\) (Quality)

b. John came. \((p)\)
1. \(s \subseteq |p|\)
2. \(s \not\subseteq |q|\)
3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup |q|\)

   \[\begin{array}{c}
   \text{exhaustivity!}
   \end{array}\]

5. \(s \subseteq |q|\) (Quantity)

6. \(s \subseteq |q|\) (Relation)

7. \(s \subseteq |q|\) (Relation)


b. John came. \((p)\)
1. \(s \subseteq |p|\)
2. \(s \not\subseteq |q|\)
3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup |q|\)

[c. John came, or Mary and John. \((p \lor (p \land q))\)]

1. \(s \subseteq |p \lor (p \land q)| = |p|\)
2. \(s \not\subseteq |q|\)
3. \(-\quad p \lor (p \land q) \models p \lor q \lor (p \land q)\)

1. \(s \subseteq |p \lor (p \land q)| = |p|\)
2. \(s \not\subseteq |q|\)
3. \(-\quad p \lor (p \land q) \models p \lor q \lor (p \land q)\)
3.2. Formal results

Recall: \( A \text{ entails } Q \), \( A \models Q \), iff

(i) \( \bigcup A \subseteq \bigcup Q \); and

(ii) for all \( q \in Q \), \( q \cap \bigcup A = \emptyset \) or \( q \cap \bigcup A \in A \)
3.2. Formal results

Recall: \( A \) entails \( Q \), \( A \vdash Q \), iff
(i) \( \bigcup A \subseteq \bigcup Q \); and
(ii) for all \( q \in Q \), \( q \cap \bigcup A = \emptyset \) or \( q \cap \bigcup A \in A \)

Relation implicature
For a cooperative speaker with info \( s \), responding \( A \) to \( Q \):
3.2. Formal results

Recall: A \emph{entails} Q, \( A \models Q \), iff

(i) \( \bigcup A \subseteq \bigcup Q \); and

(ii) for all \( q \in Q \), \( q \cap \bigcup A = \emptyset \) or \( q \cap \bigcup A \in A \)

Relation implicature

For a cooperative speaker with info \( s \), responding \( A \) to \( Q \):

(i) \( \bigcup A \cap s \subseteq \bigcup Q \)

(ii) \ldots
3.2. Formal results

Recall: \( A \) entails \( Q \), \( A \models Q \), iff

(i) \( \cup A \subseteq \cup Q \); and

(ii) for all \( q \in Q \), \( q \cap \cup A = \emptyset \) or \( q \cap \cup A \in A \)

Relation implicature

For a cooperative speaker with info \( s \), responding \( A \) to \( Q \):

(i) \( s \subseteq \overline{\cup A} \cup \cup Q \)

(ii) \( \ldots \)
3.2. Formal results

Recall: $A$ entails $Q$, $A \vDash Q$, iff
(i) $\bigcup A \subseteq \bigcup Q$; and
(ii) for all $q \in Q$, $q \cap \bigcup A = \emptyset$ or $q \cap \bigcup A \in A$

Relation implicature

For a cooperative speaker with info $s$, responding $A$ to $Q$:
(i) $s \subseteq \overline{\bigcup A} \cup \bigcup Q$
(ii) for all $q \in Q$, 
3.2. Formal results

Recall: $A$ entails $Q$, $A \models Q$, iff
(i) $\bigcup A \subseteq \bigcup Q$; and
(ii) for all $q \in Q$, $q \cap \bigcup A = \emptyset$ or $q \cap \bigcup A \in A$

Relation implicature

For a cooperative speaker with info $s$, responding $A$ to $Q$:
(i) $s \subseteq \overline{\bigcup A} \cup \bigcup Q$
(ii) for all $q \in Q$, $q \cap \bigcup A \cap s = \emptyset$ or \ldots
3.2. Formal results

Recall: A entails Q, $A \models Q$, iff

(i) $\bigcup A \subseteq \bigcup Q$; and
(ii) for all $q \in Q$, $q \cap \bigcup A = \emptyset$ or $q \cap \bigcup A \in A$

Relation implicature

For a cooperative speaker with info s, responding A to Q:

(i) $s \subseteq \overline{\bigcup A} \cup \bigcup Q$
(ii) for all $q \in Q$, $s \subseteq \overline{\bigcup A} \cup \overline{q}$ or ...
3.2. Formal results

Recall: $A$ entails $Q$, $A \models Q$, iff

(i) $\bigcup A \subseteq \bigcup Q$; and
(ii) for all $q \in Q$, $q \cap \bigcup A = \emptyset$ or $q \cap \bigcup A \in A$

Relation implicature

For a cooperative speaker with info $s$, responding $A$ to $Q$:

(i) $s \subseteq \bigcup \overline{A} \cup \bigcup Q$
(ii) for all $q \in Q$, $s \subseteq \bigcup \overline{A} \cup \overline{q}$ or there is an $a \in A$ s.t. given $s$, $q \cap \bigcup A$ and $a$ coincide.
3.2. Formal results

Recall: A entails Q, $A \vdash Q$, iff
(i) $\bigcup A \subseteq \bigcup Q$; and
(ii) for all $q \in Q$, $q \cap \bigcup A = \emptyset$ or $q \cap \bigcup A \in A$

Relation implicature

For a cooperative speaker with info $s$, responding $A$ to $Q$:
(i) $s \subseteq \overline{\bigcup A} \cup \bigcup Q$
(ii) for all $q \in Q$, $s \subseteq \overline{\bigcup A} \cup \overline{q}$ or there is an $a \in A$ s.t. $s \subseteq (q \cap \bigcup A \cap \overline{a}) \cup (q \cap \bigcup A \cap a)$
3.2. Formal results

Recall: \( A \) entails \( Q \), \( A \models Q \), iff
(i) \( \bigcup A \subseteq \bigcup Q \); and
(ii) for all \( q \in Q \), \( q \cap \bigcup A = \emptyset \) or \( q \cap \bigcup A \in A \)

Relation implicature

For a cooperative speaker with info \( s \), responding \( A \) to \( Q \):
(i) \( s \subseteq \overline{\bigcup A} \cup \bigcup Q \)
(ii) for all \( q \in Q \), \( s \subseteq \overline{\bigcup A} \cup \overline{q} \) or there is an \( a \in A \) s.t.
\( s \subseteq (q \cap \bigcup A \cap \overline{a}) \cup (q \cap \bigcup A \cap a) \)
3.2. Formal results

Recall: \( A \) entails \( Q \), \( A \models Q \), iff
(i) \( \bigcup A \subseteq \bigcup Q \); and
(ii) for all \( q \in Q \), \( q \cap \bigcup A = \emptyset \) or \( q \cap \bigcup A \in A \)

Relation implicature

For a cooperative speaker with info \( s \), responding \( A \) to \( Q \):
(i) \( s \subseteq \overline{\bigcup A} \cup \bigcup Q \)
(ii) for all \( q \in Q \), \( s \subseteq \overline{\bigcup A} \cup \overline{q} \) or there is an \( a \in A \) s.t. 
\( s \subseteq (q \cap \overline{\bigcup A} \cap \overline{a}) \cup (q \cap \overline{\bigcup A} \cap a) \)

Relation implicature for singleton answer

And if responding \( \{a\} \) to \( Q \) for some \( a \in Q \):
3.2. Formal results

Recall: \( A \) entails \( Q \), \( A \models Q \), iff
(i) \( \bigcup A \subseteq \bigcup Q \); and
(ii) for all \( q \in Q \), \( q \cap \bigcup A = \emptyset \) or \( q \cap \bigcup A \in A \)

Relation implicature

For a cooperative speaker with info \( s \), responding \( A \) to \( Q \):
(i) \( s \subseteq \overline{\bigcup A} \cup \bigcup Q \)
(ii) for all \( q \in Q \), \( s \subseteq \overline{\bigcup A} \cup \overline{q} \) or there is an \( a \in A \) s.t. \( s \subseteq (q \cap \overline{\bigcup A} \cap \overline{a}) \cup (q \cap \bigcup A \cap a) \)

Relation implicature for singleton answer

And if responding \( \{a\} \) to \( Q \) for some \( a \in Q \):
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Recall: A entails \( Q \), \( A \models Q \), iff
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Relation implicature
For a cooperative speaker with info \( s \), responding \( A \) to \( Q \):
(i) \( s \subseteq \overline{\bigcup A} \cup \bigcup Q \)
(ii) for all \( q \in Q \), \( s \subseteq \overline{\bigcup A} \cup \overline{q} \) or there is an \( a \in A \) s.t.
\( s \subseteq (q \cap \bigcup A \cap \overline{a}) \cup (q \cap \bigcup A \cap a) \)

Relation implicature for singleton answer
And if responding \( \{a\} \) to \( Q \) for some \( a \in Q \):
for all \( q \in Q \),
3.2. Formal results

Recall: \( A \text{ entails } Q \), \( A \models Q \), iff
(i) \( \bigcup A \subseteq \bigcup Q \); and
(ii) for all \( q \in Q \), \( q \cap \bigcup A = \emptyset \) or \( q \cap \bigcup A \in A \)

Relation implicature

For a cooperative speaker with info \( s \), responding \( A \) to \( Q \):
(i) \( s \subseteq \bigcup A \cup \bigcup Q \)
(ii) for all \( q \in Q \), \( s \subseteq \bigcup A \cup \overline{q} \) or there is an \( a \in A \) s.t.
\( s \subseteq (q \cap \bigcup A \cap \overline{a}) \cup (q \cap \bigcup A \cap a) \)

Relation implicature for singleton answer

And if responding \( \{a\} \) to \( Q \) for some \( a \in Q \):
for all \( q \in Q \), \( s \subseteq \overline{a} \cup \overline{q} \) or \ldots
3.2. Formal results

Recall: $A$ entails $Q$, $A \models Q$, iff
(i) $\bigcup A \subseteq \bigcup Q$; and
(ii) for all $q \in Q$, $q \cap \bigcup A = \emptyset$ or $q \cap \bigcup A \in A$

Relation implicature
For a cooperative speaker with info $s$, responding $A$ to $Q$:
(i) $s \subseteq \overline{\bigcup A} \cup \bigcup Q$
(ii) for all $q \in Q$, $s \subseteq \overline{\bigcup A} \cup \overline{q}$ or there is an $a \in A$ s.t.
$s \subseteq (q \cap \bigcup A \cap \overline{a}) \cup (q \cap \bigcup A \cap a)$

Relation implicature for singleton answer
And if responding $\{a\}$ to $Q$ for some $a \in Q$:
for all $q \in Q$, $s \subseteq \overline{a} \cup \overline{q}$ or $s \subseteq (q \cap a \cap \overline{a}) \cup (q \cap a \cap a)$
3.2. Formal results

Recall: \( A \) entails \( Q \), \( A \models Q \), iff
(i) \( \bigcup A \subseteq \bigcup Q \); and
(ii) for all \( q \in Q \), \( q \cap \bigcup A = \emptyset \) or \( q \cap \bigcup A \in A \)

Relation implicature
For a cooperative speaker with info \( s \), responding \( A \) to \( Q \):
(i) \( s \subseteq \overline{\bigcup A} \cup \bigcup Q \)
(ii) for all \( q \in Q \), \( s \subseteq \overline{\bigcup A} \cup \overline{q} \) or there is an \( a \in A \) s.t.
\( s \subseteq (q \cap \bigcup A \cap \overline{a}) \cup (q \cap \bigcup A \cap a) \)

Relation implicature for singleton answer
And if responding \( \{a\} \) to \( Q \) for some \( a \in Q \):
for all \( q \in Q \), \( s \subseteq \overline{a} \cup \overline{q} \) or \( s \subseteq \overline{a} \cup q \)
3.2. Formal results

Recall: $A$ entails $Q$, $A \models Q$, iff
(i) $\bigcup A \subseteq \bigcup Q$; and
(ii) for all $q \in Q$, $q \cap \bigcup A = \emptyset$ or $q \cap \bigcup A \in A$

Relation implicature

For a cooperative speaker with info $s$, responding $A$ to $Q$:
(i) $s \subseteq \overline{\bigcup A} \cup \bigcup Q$
(ii) for all $q \in Q$, $s \subseteq \overline{\bigcup A} \cup \overline{q}$ or there is an $a \in A$ s.t. $s \subseteq (q \cap \bigcup A \cap \overline{a}) \cup (q \cap \bigcup A \cap a)$

Relation implicature for singleton answer

And if responding $\{a\}$ to $Q$ for some $a \in Q$:
for all $q \in Q$, $s \subseteq \overline{a} \cup \overline{q}$ or $s \subseteq \overline{a} \cup q$
3.3. And more conceptually...

- The maxim of Relation requires that:
  for each possibility the speaker *leaves unattended*, the speaker
  knows how it depends on the information she provided.
3.3. And more conceptually...

- The maxim of Relation requires that:
  for each possibility the speaker *leaves unattended*, the speaker knows how it depends on the information she provided.
- Together with Quality, this implies *opinionatedness*.
3.3. And more conceptually...

- The maxim of Relation requires that: for each possibility the speaker *leaves unattended*, the speaker knows how it depends on the information she provided.
- Together with Quality, this implies *opinionatedness*.
- Together with Quantity, this in turn yields exhaustivity.
3.3. And more conceptually...

- The maxim of Relation requires that: for each possibility the speaker *leaves unattended*, the speaker knows how it depends on the information she provided.

- Together with Quality, this implies *opinionatedness*.

- Together with Quantity, this in turn yields exhaustivity.

Main conclusion:
3.3. And more conceptually...

- The maxim of Relation requires that: for each possibility the speaker *leaves unattended*, the speaker knows how it depends on the information she provided.
- Together with Quality, this implies *opinionatedness*.
- Together with Quantity, this in turn yields exhaustivity.

Main conclusion:
- If pragmatic reasoning is sensitive to *attentive content*
3.3. And more conceptually...

- The maxim of Relation requires that:
  for each possibility the speaker *leaves unattended*, the speaker knows how it depends on the information she provided.
- Together with Quality, this implies *opinionatedness*.
- Together with Quantity, this in turn yields exhaustivity.

Main conclusion:
- If pragmatic reasoning is sensitive to *attentive content* (which it must be, to distinguish between (3b) and (3c));
3.3. And more conceptually...

- The maxim of Relation requires that: for each possibility the speaker leaves unattended, the speaker knows how it depends on the information she provided.
- Together with Quality, this implies opinionatedness.
- Together with Quantity, this in turn yields exhaustivity.

Main conclusion:
- If pragmatic reasoning is sensitive to attentive content (which it must be, to distinguish between (3b) and (3c));
- then exhaustivity is a conversational implicature.
4. Discussion

4.1. ‘Alternatives’
4.2. Semantics
4.3. Semantic desiderata
4.4. ‘Gricean’?
4.5. Grice vs. grammar
4.6. Other maxims of Relation
4.7. Relatedness and knowledge
4.8. Logical relatedness
4.1. ‘Alternatives’

Existing approaches (since forever):

- ‘Why did the speaker not say “p ∧ q”?’

Beware:

- These ‘alternatives’ are fully determined by the maxims.
- Speakers need not reason in terms of alternatives.
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- ‘Why did the speaker not say “p \land q”?’
- Mere ignorance is sufficient reason.

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* ‘Why did the speaker not say “p ∨ (p ∧ q)”?’

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My approach:
  ▶ ‘Why did the speaker not say “\( p \lor (p \land q) \)”?’
  ▶ *Ignorance is no excuse.*
  ▶ Hence something stronger is implied: exhaustivity.
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4.2. Semantics

Restriction

A restricted to b, \( A_b := \{ a \cap b \mid a \in A, a \cap b \neq \emptyset \} \)

Semantics (Roelofsen, 2011)

1. \([p] = \{ \{ w \in \textbf{Worlds} \mid w(p) = \text{true} \} \}\)
2. \([\neg \varphi] = \{ \bigcup[\varphi] \} \text{ if } \bigcup[\varphi] \text{ is nonempty; } \emptyset \text{ otherwise.} \)
3. \([\varphi \lor \psi] = (\bigcup[\varphi] \cup \bigcup[\psi])_{|\varphi| \cup |\psi|} = \bigcup[\varphi] \cup \bigcup[\psi] \)
4. \([\varphi \land \psi] = (\bigcup[\varphi] \cup \bigcup[\psi])_{|\varphi| \cap |\psi|} \)
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Attentive semantics is not the only suitable semantics:

- Unrestricted Inquisitive Sem. (Ciardelli, 2009; Westera, 2012)
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Attentive semantics is not the only suitable semantics:

- Unrestricted Inquisitive Sem. (Ciardelli, 2009; Westera, 2012)

Minimally, the semantics must lack the absorption laws:

- Absorption: \( p \lor (p \land q) \equiv p \equiv p \land (p \lor q) \)
4.3. Semantic desiderata

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- No downward closure (cf. Basic Inquisitive Semantics).

Questions, the responses to which may be exhaustified, are not partitions. (cf. Groenendijk and Stokhof, 1984; cf. 'mention-some').

Wh-words are existential quantifiers over sets.
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- The semantics treats informative content classically.
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- The connectives are still algebraically ‘basic’.

Besides: this is the only way.
4.5. Grice vs. grammar

Perhaps the dominant approach to exhaustivity today:

perhaps invisible exhaustivity operators in our grammar.

They come in at night, unseen, unheard - no one understands their motives.

They are inserted 'by default', unless canceled (and variations on this theme).

Main arguments (Chierchia, et al., 2008):

'Grice cannot deal with the epistemic step, grammar can.'

'Grice cannot handle 'embedded implicatures', grammar can.'

Response:

Grice can do it; and the grammatical approach needs him.
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i. $R_s \models Q$  

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ii. $R_{CG} \models Q$  

(iii. $R_h \models Q$ (≈ GS’s (1984) pragmatic answer))

ii. and iii. are too strong: The participants need not already know how $R$ is relevant.

They need only be able to figure it out. (left implicit here)

(4) Did John go to the party?

It was raining.

If it rained, John \{went / didn’t go\}.
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i. \( R_s \vdash Q \) 
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(4) Did John go to the party?
   It was raining. \( \sim \) If it rained, John \{went / didn’t go\}.
4.7. Relatedness and knowledge

\[ R_s \models Q \quad \text{‘the speaker knows how } R \text{ is related to } Q \]
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\[ R_s = Q \quad \text{‘the speaker knows how } R \text{ is related to } Q' \]

Relatedness

\[ A \text{ is } \text{related} \text{ to } Q \text{ in world } w \text{ iff for some fact } f, w \in f, A_f \models Q. \]
4.7. Relatedness and knowledge

\[ R_s \models Q \]  ‘the speaker *knows how* \( R \) is related to \( Q \)

**Relatedness**

A is *related* to \( Q \) in world \( w \) iff for some fact \( f \), \( w \in f \), \( A_f \models Q \).

- The speaker *knows that* \( A \) is related to \( Q \) iff in all \( w \in s \), \( A \) is rel. to \( Q \).
4.7. Relatedness and knowledge

$R_s \models Q$ \: \text{‘the speaker \textit{knows how} $R$ is related to $Q$’}

**Relatedness**

$A$ is \textit{related} to $Q$ in world $w$ iff for some fact $f$, $w \in f$, $A_f \models Q$.

- The speaker \textit{knows that} $A$ is related to $Q$ iff in all $w \in s$, $A$ is rel. to $Q$.
- The speaker \textit{knows how} $A$ is related to $Q$ iff in all $w \in s$, $A$ is related to $Q$ \textit{by the same} $f$.
4.7. Relatedness and knowledge

\( R_s \models Q \) \quad ‘the speaker knows how \( R \) is related to \( Q \)’

**Relatedness**

\( A \) is *related* to \( Q \) in world \( w \) iff for some fact \( f \), \( w \in f \), \( A_f \models Q \).

- The speaker *knows that* \( A \) is related to \( Q \) iff in all \( w \in s \), \( A \) is rel. to \( Q \).
- The speaker *knows how* \( A \) is related to \( Q \) iff in all \( w \in s \), \( A \) is related to \( Q \) *by the same* \( f \).

Now:

- For all \( A, Q \) true in \( w \):
  - there is a fact \( f \), \( w \in f \), s.t. \( A_f \models Q \).
4.7. Relatedness and knowledge

\[ R_s \models Q \quad \text{‘the speaker knows how } R \text{ is related to } Q \’ \]

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A is *related* to Q in world w iff for some fact \( f \), \( w \in f \), \( A_f \models Q \).

- The speaker *knows that* A is related to Q iff in all \( w \in s \), A is related to Q.
- The speaker *knows how* A is related to Q iff in all \( w \in s \), A is related to Q by the same \( f \).

Now:

- For all A, Q true in \( w \):
  there is a fact \( f \), \( w \in f \), s.t. \( A_f \models Q \).
  (e.g., let \( f \) be \( \{w\} \))
4.7. Relatedness and knowledge

$R_s \models Q$ ‘the speaker knows how $R$ is related to $Q$’

**Relatedness**

$A$ is *related* to $Q$ in world $w$ iff for some fact $f$, $w \in f$, $A_f \models Q$.

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Now:

- For all $A, Q$ true in $w$:
  there is a fact $f$, $w \in f$, s.t. $A_f \models Q$.
  (e.g., let $f$ be $\{w\}$)

  *Within a world, everything is related.*
4.8. Logical relatedness

Just as [logical consequence] rules the validity of argumentation, [logical relatedness] rules the coherence of information exchange.

(Groenendijk and Roelofsen, 2009)
4.8. Logical relatedness

*Just as [logical consequence] rules the validity of argumentation, [logical relatedness] rules the coherence of information exchange.*

(Groenendijk and Roelofsen, 2009)

(6) Dogs and cats are mammals.  (Logical cons.)
Dogs are mammals.

(7) Dogs are mammals.

Relatedness:

A is related to Q in world w iff for some fact f, w \in f.

Logical iff f captures all and only the laws of logic.

Non-logical iff f is a contingency.
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Just as [logical consequence] rules the validity of argumentation, [logical relatedness] rules the coherence of information exchange.

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(7) Dogs are mammals. + world knowledge  
Dogs are animals.  
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A is related to Q in world w iff for some fact f, w ∈ f, A_f ⊨ Q.

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Just as [logical consequence] rules the validity of argumentation, [logical relatedness] rules the coherence of information exchange.

(Groenendijk and Roelofsen, 2009)

(6) \text{Dogs and cats are mammals.} + \text{logic} \quad \text{(Logical cons.)}

Dogs are mammals.

(7) \text{Dogs are mammals.} + \text{world knowledge} \quad \text{(Non-logical cons.)}

Dogs are animals.

Relatedness

(A is related to Q in world w iff for some fact f, w ∈ f, A_f ⊨ Q.)

▶ Logical iff f captures all and only the laws of logic.
▶ Non-logical iff f is a contingency.

Logical consequence is logical relatedness.
End of Part I
Two puzzles

(1) Of John, Bill and Mary, who came to the party?
a. John came ↓.  ¬ Mary and Bill didn’t.
b. John came ↑.
   ¬ ...wait, there’s more.
   ¬ ...perhaps that implies sth. about M&B?
   ¬ ...but I’m not sure.
   ¬ ...did I make myself clear?
Part II

5. Analysis
6. Results
7. Discussion
5. Analysis
5. Analysis

(1) Of John, Bill and Mary, who came to the party?
  b. John came.
   \( \sim \) ...wait, there’s more.
   \( \sim \) ...perhaps that implies sth. about M&B?
   \( \sim \) ...but I’m not sure.
   \( \sim \) ...did I make myself clear?
5. Analysis

(1) Of John, Bill and Mary, who came to the party?
   b. John came \( \rightarrow L \).
      \[ \leadsto \ldots \text{wait, there’s more.} \]
      \[ \leadsto \ldots \text{perhaps that implies sth. about M&B?} \]
   c. John came \( \rightarrow H \).
      \[ \leadsto \ldots \text{but I’m not sure.} \]
      \[ \leadsto \ldots \text{did I make myself clear?} \]
5. Analysis

(1) Of John, Bill and Mary, who came to the party?
   b. John came $\nearrow^L$.
      $\leadsto$ ...wait, there’s more.  (Quantity)
      $\leadsto$ ...perhaps that implies sth. about M&B?
   c. John came $\nearrow^H$.
      $\leadsto$ ...but I’m not sure.
      $\leadsto$ ...did I make myself clear?
5. Analysis

(1) Of John, Bill and Mary, who came to the party?
   b. John came \( \rightarrow \mathcal{L} \).
   \( \sim \) ...wait, there’s more. \hspace{1cm} \text{(Quantity)}
   \( \sim \) ...perhaps that implies sth. about M&B? \hspace{1cm} \text{(Relation)}
   c. John came \( \rightarrow \mathcal{H} \).
   \( \sim \) ...but I’m not sure.
   \( \sim \) ...did I make myself clear?
5. Analysis

(1) Of John, Bill and Mary, who came to the party?
   
   b. John came $\uparrow^L$.
       $\leadsto$ ...wait, there’s more.  
       $\leadsto$ ...perhaps that implies sth. about M&B?  
   c. John came $\uparrow^H$.
       $\leadsto$ ...but I’m not sure.
       $\leadsto$ ...did I make myself clear?

Proposal

1. The final rise marks the violation of a maxim.
5. Analysis

(1) Of John, Bill and Mary, who came to the party?
   b. John came $\nearrow^L$.
      $\leadsto$ ...wait, there’s more. (Quantity)
      $\leadsto$ ...perhaps that implies sth. about M&B? (Relation)
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      $\sim \ldots$ did I make myself clear? (Manner)

Proposal

1. The final rise marks the violation of a maxim.
5. Analysis

(1) Of John, Bill and Mary, who came to the party?
   b. John came \( \Rightarrow L \).
      \( \sim \) ...wait, there’s more. \hspace{1cm} (Quantity)
      \( \sim \) ...perhaps that implies sth. about M&B? \hspace{1cm} (Relation)
   c. John came \( \Rightarrow H \).
      \( \sim \) ...but I’m not sure. \hspace{1cm} (Quality)
      \( \sim \) ...did I make myself clear? \hspace{1cm} (Manner)

Proposal

1. The final rise marks the violation of a maxim.
2. Its pitch conveys the severity of the violation:
   \( \Rightarrow H \): Quality/Manner; \hspace{1cm} (cf. Ward & Hirschberg, 1992;
   \( \Rightarrow L \): Quantity/Relation. \hspace{1cm} Banziger & Scherer, 2005)
5. Analysis

(1) Of John, Bill and Mary, who came to the party?

b. John came $\nearrow L$.

$\leadsto$ ...wait, there’s more.  
$\leadsto$ ...perhaps that implies sth. about M&B?  

(Quantity)  
(Relation)

c. John came $\nearrow H$.

$\leadsto$ ...but I’m not sure.  
$\leadsto$ ...did I make myself clear?  

(Quality)  
(Manner)

Proposal

1. The final rise marks the violation of a maxim.

2. Its pitch conveys the severity of the violation:

$\nearrow H$: Quality/Manner;  
$\nearrow L$: Quantity/Relation.  

(cf. Ward & Hirschberg, 1992;  
Banziger & Scherer, 2005)

_This proposal is new in its generality, not in spirit._
6. Results

6.1. Example
6.2. Formal results
6.3. General results
6.1. Example

(8) Of J and M, who came to the party? \( (p \lor q \lor (p \land q)) \)

John came \( \uparrow \).

---

Readings

\( \checkmark \) ...wait, there's more. (Quantity)
\( \checkmark \) ...perhaps that implies sth. about Mary? (Relation)
\( \checkmark \) ...but I'm not sure. (Quality)
\( \checkmark \) ...did I make myself clear? (Manner)

Furthermore:

Exhaustivity disappears in all readings except Manner.

Complete answers lack Relation/Quantity reading.

(Except in sarcastic pretense)
6.1. Example

(8) Of J and M, who came to the party? \( (p \lor q \lor (p \land q)) \)

John came \( \uparrow \).

Readings

...wait, there’s more. \( \text{ (Quantity) } \)
...perhaps that implies sth. about Mary? \( \text{ (Relation) } \)
...but I’m not sure. \( \text{ (Quality) } \)
...did I make myself clear? \( \text{ (Manner) } \)
6.1. Example

(8) Of J and M, who came to the party? John came.

\( p \lor q \lor (p \land q) \)

1. \( s \subseteq |p| \) (Quality)
2. \( s \not\subseteq |q| \) (Quantity)
3. \( s \subseteq |p| \cup |q| \) or \( s \subseteq \overline{|p|} \cup \overline{|q|} \) (Relation)

Readings

...wait, there’s more. (Quantity)
...perhaps that implies sth. about Mary? (Relation)
...but I’m not sure. (Quality)
...did I make myself clear? (Manner)
6.1. Example

(8) Of J and M, who came to the party? \((p \lor q \lor (p \land q))\)

John came ↑.

1. \(s \subseteq |p|\)  
   (Quality)
2. \(s \notin |q|\)  
   (Quantity)
3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup \bar{|q|}\)  
   (Relation)
4. The speaker thinks she is clear, concise, etc.  
   (Manner)

Readings

...wait, there’s more.  
(Quantity)

...perhaps that implies sth. about Mary?  
(Relation)

...but I’m not sure.  
(Quality)

...did I make myself clear?  
(Manner)
6.1. Example

(8) Of J and M, who came to the party? \((p \lor q \lor (p \land q))\)

John came \(\Rightarrow\).

1. \(s \notin |p|\)
2. \(s \notin |q|\)
3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup |q|\)
4. The speaker thinks she is clear, concise, etc.

Readings

...wait, there’s more. \(\text{(Quantity)}\)

...perhaps that implies sth. about Mary? \(\text{(Relation)}\)

...but I’m not sure. \(\text{(Quality)}\)

...did I make myself clear? \(\text{(Manner)}\)
6.1. Example

(8) Of J and M, who came to the party? \((p \lor q \lor (p \land q))\)

John came \(\uparrow\).

1. \(s \notin |p|\)
2. \(s \notin |q|\)
3. \(s \subseteq |p| \cup |q| \) or \(s \subseteq |p| \cup |q|\)
4. The speaker thinks she is clear, concise, etc.

Readings

...wait, there’s more. \((\text{Quantity})\)

...perhaps that implies sth. about Mary? \((\text{Relation})\)

✓ ...but I’m not sure. \((\text{Quality})\)

✓ ...did I make myself clear? \((\text{Manner})\)
6.1. Example

(8) Of J and M, who came to the party?  \( (p \lor q \lor (p \land q)) \)

John came ↗.

1. \( s \subseteq |p| \)  
2. \( s \not\subseteq |q| \)  
3. \( s \subseteq |p| \cup \ |q| \) or \( s \subseteq |p| \cup |q| \)  
4. The speaker thinks she is clear, concise, etc.

Readings

...wait, there’s more. \( (p) \)  
...perhaps that implies sth. about Mary? \( (p) \)  
✓ ...but I’m not sure. \( (p) \)  
✓ ...did I make myself clear? \( (p) \)
6.1. Example

(8) Of J and M, who came to the party? \((p \lor q \lor (p \land q))\)

John came \(\uparrow\).

1. \(s \subseteq |p|\) (Quality)
2. \(s \subseteq |q|\) (\(\uparrow\))
3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup |q|\) (Relation)
4. The speaker thinks she is clear, concise, etc. (Manner)

Readings

...wait, there’s more. (Quantity)

...perhaps that implies sth. about Mary? (Relation)

\(\checkmark\) ...but I’m not sure. (Quality)

...did I make myself clear? (Manner)
6.1. Example

(8) Of J and M, who came to the party? \((p \lor q \lor (p \land q))\)

\(p\) \(\uparrow\)

1. \(s \subseteq |p|\) \(\text{(Quality)}\)
2. \(s \subseteq |q|\) \(\text{(\(\uparrow\))}\)
3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup |q|\) \(\text{(Relation)}\)
4. The speaker thinks she is clear, concise, etc. \(\text{(Manner)}\)

Readings

✓ ...wait, there’s more. \(\text{(Quantity)}\)
   ...perhaps that implies sth. about Mary? \(\text{(Relation)}\)
✓ ...but I’m not sure. \(\text{(Quality)}\)
   ...did I make myself clear? \(\text{(Manner)}\)
6.1. Example

(8) Of J and M, who came to the party? \( (p \lor q \lor (p \land q)) \)

John came \( \uparrow \).

1. \( s \subseteq |p| \) (Quality)
2. \( s \not\subseteq |q| \) (Quantity)
3. \( s \subseteq |p| \cup |q| \) or \( s \subseteq |p| \cup |q| \) (Relation)
4. The speaker thinks she is clear, concise, etc. (Manner)

Readings

✓ ...wait, there’s more. (Quantity)
   ...perhaps that implies sth. about Mary? (Relation)
✓ ...but I’m not sure. (Quality)
   ...did I make myself clear? (Manner)
6.1. Example

(8) Of J and M, who came to the party? \((p ∨ q ∨ (p ∧ q))\)

John came \(↑\).

1. \(s \subseteq |p|\)
2. \(s \notin |q|\)
3. \(s \notin |p| \cup |q|\) and \(s \notin \overline{|p|} \cup \overline{|q|}\)
4. The speaker thinks she is clear, concise, etc.

Readings

✓ ...wait, there’s more.
   ...perhaps that implies sth. about Mary?

✓ ...but I’m not sure.
   ...did I make myself clear?
6.1. Example

(8) Of J and M, who came to the party? \((p \lor q \lor (p \land q))\)

John came \(\uparrow\).

1. \(s \subseteq |p|\)  
2. \(s \nsubseteq |q|\)
3. \(s \nsubseteq |p| \cup |q| \) and \(s \nsubseteq |p| \cup \overline{|q|}\)
4. The speaker thinks she is clear, concise, etc.

Readings

\(\checkmark\) ...wait, there’s more.  \((\text{Quantity})\)
\(\checkmark\) ...perhaps that implies sth. about Mary? \((\text{Relation})\)
\(\checkmark\) ...but I’m not sure.

...did I make myself clear?

\(\checkmark\) ...did I make myself clear? \((\text{Manner})\)
6.1. Example

(8) Of J and M, who came to the party? 

\[ p \lor q \lor (p \land q) \]

John came ↑.

1. \( s \subseteq |p| \)  
   (Quality)
2. \( s \notin |q| \)  
   (Quantity)
3. \( s \subseteq |p| \cup |q| \) or \( s \subseteq |p| \cup |q| \)  
   (Relation)
4. The speaker thinks she is clear, concise, etc.  
   (Manner)

Readings

✓ ...wait, there’s more.  
   (Quantity)
✓ ...perhaps that implies sth. about Mary?  
   (Relation)
✓ ...but I’m not sure.  
   (Quality)
   ...did I make myself clear?  
   (Manner)
6.1. Example

(8) Of J and M, who came to the party?  
\[ (p \lor q \lor (p \land q)) \]
John came \( \nearrow \).

1. \( s \subseteq |p| \)  
2. \( s \notin |q| \)  
3. \( s \subseteq |p| \cup |q| \) or \( s \subseteq \overline{|p|} \cup \overline{|q|} \)  
4. The speaker doesn’t think she’s clear, concise, etc. \( \nearrow \)

Readings

✓ ...wait, there’s more. \( \text{(Quantity)} \)
✓ ...perhaps that implies sth. about Mary? \( \text{(Relation)} \)
✓ ...but I’m not sure. \( \text{(Quality)} \)
   ...did I make myself clear? \( \text{(Manner)} \)
6.1. Example

(8) Of J and M, who came to the party? \((p \lor q \lor (p \land q))\)

John came \(\uparrow\).

1. \(s \subseteq |p|\) (Quality)
2. \(s \notin |q|\) (Quantity)
3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup |q|\) (Relation)
4. The speaker doesn’t think she’s clear, concise, etc. (\(\uparrow\))

Readings

✓ ...wait, there’s more. (Quantity)
✓ ...perhaps that implies sth. about Mary? (Relation)
✓ ...but I’m not sure. (Quality)
✓ ...did I make myself clear? (Manner)
6.1. Example

(8) Of J and M, who came to the party? \( (p \lor q \lor (p \land q)) \)

John came ↗.

1. \( s \subseteq |p| \) \hspace{1cm} (Quality)
2. \( s \notin |q| \) \hspace{1cm} (Quantity)
3. \( s \subseteq |p| \cup |q| \) or \( s \subseteq |p| \cup |q| \) \hspace{1cm} (Relation)
4. The speaker doesn’t think she’s clear, concise, etc. \( (\rightarrow) \)

Readings

✓ ...wait, there’s more. \hspace{1cm} (Quantity)
✓ ...perhaps that implies sth. about Mary? \hspace{1cm} (Relation)
✓ ...but I’m not sure. \hspace{1cm} (Quality)
✓ ...did I make myself clear? \hspace{1cm} (Manner)

Furthermore:

\[
\text{Exhaustivity disappears in all readings except Manner.}
\]

\[
\text{Complete answers lack Relation/Quantity reading.}
\]
6.1. Example

(8) Of J and M, who came to the party? \( (p \lor q \lor (p \land q)) \)

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4. The speaker doesn’t think she’s clear, concise, etc. \( \uparrow \)

Readings

- ✓ ...wait, there’s more. (Quantity)
- ✓ ...perhaps that implies sth. about Mary? (Relation)
- ✓ ...but I’m not sure. (Quality)
- ✓ ...did I make myself clear? (Manner)

Furthermore:
  - Exhaustivity disappears in all readings except Manner.
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(8) Of J and M, who came to the party? \( (p \lor q \lor (p \land q)) \)

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2. \( s \not\subseteq |q| \) (Quantity)
3. \( s \subseteq |p| \cup |q| \) or \( s \subseteq |p| \cup |q| \) (Relation)
4. The speaker doesn’t think she’s clear, concise, etc. (↗)

Readings

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✓ ...did I make myself clear? (Manner)

Furthermore:

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(8) Of J and M, who came to the party? \((p \lor q \lor (p \land q))\)

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1. \(s \subseteq |p|\)  \(\text{(Quality)}\)
2. \(s \notin |q|\)  \(\text{(Quantity)}\)
3. \(s \subseteq |p| \cup |q|\) or \(s \subseteq |p| \cup |q|\)  \(\text{(Relation)}\)
4. The speaker doesn’t think she’s clear, concise, etc.  \(\text{(\(\uparrow\))}\)

Readings

✓ ...wait, there’s more.  \(\text{(Quantity)}\)
✓ ...perhaps that implies sth. about Mary?  \(\text{(Relation)}\)
✓ ...but I’m not sure.  \(\text{(Quality)}\)
✓ ...did I make myself clear?  \(\text{(Manner)}\)

Furthermore:

- Exhaustivity disappears in all readings except Manner.
- Complete answers lack Relation/Quantity reading.
  (Except in sarcastic pretense)
6.2. Formal results

Relation violation
For sp. with info $s$, responding $A$ to $Q$, violating Relation:

\[
\text{(i)} \quad s \cap A \cup Q;
\]
\[
\text{(ii)} \quad \text{for } q \in Q, \quad s \cap A \cup q \quad \text{and for } a \in A, \quad s \cap \left(q \cap \left( A \setminus a \right) \cup \left(q \cap \left( A \setminus a \right) \right) \right)
\]
6.2. Formal results

Relation violation
For sp. with info $s$, responding $A$ to $Q$, violating Relation:
(i) $s \subseteq \overline{A} \cup \overline{Q}$; and
(ii) for all $q \in Q$, $s \subseteq \overline{A} \cup \overline{q}$ and for some $a \in A$, $s \subseteq \overline{q \cap \overline{A} \cap \overline{a}} \cup \overline{q \cap \overline{A} \cap a}$
6.2. Formal results

Relation violation
For sp. with info $s$, responding $A$ to $Q$, violating Relation:
(i) $s \notin \bigcup A \cup \bigcup Q$; or
(ii) for some $q \in Q$, $s \notin \bigcup A \cup \overline{q}$ and for all $a \in A$, $s \notin (q \cap \bigcup A \cap \overline{a}) \cup (q \cap \bigcup A \cap a)$
6.2. Formal results

**Relation violation**
For sp. with info $s$, responding $A$ to $Q$, violating Relation:
(i) $s \not\subseteq \overline{A} \cup \overline{Q}$; or
(ii) for some $q \in Q$, $s \not\subseteq \overline{A} \cup \overline{q}$ and for all $a \in A$, $s \not\subseteq (q \cap \overline{A} \cap \overline{a}) \cup (q \cap \overline{A} \cap a)$

**Relation violation on singleton answer**
And if responding $\{a\}$ to $Q$ for some $a \in Q$:
for some $q \in Q$, $s \not\subseteq \overline{a} \cup \overline{q}$ and $s \not\subseteq \overline{a} \cup q$
6.2. Formal results

**Relation violation**

For sp. with info \( s \), responding \( A \) to \( Q \), violating Relation:

(i) \( s \not\subseteq \bigcup A \cup \bigcup Q \); or

(ii) for some \( q \in Q \), \( s \not\subseteq \bigcup A \cup \overline{q} \) and for all \( a \in A \),
\[
    s \not\subseteq (q \cap \bigcup A \cap \overline{a}) \cup (q \cap \bigcup A \cap a)
\]

**Relation violation on singleton answer**

And if responding \( \{ a \} \) to \( Q \) for some \( a \in Q \):
for some \( q \in Q \), \( s \not\subseteq \overline{a} \cup \overline{q} \) and \( s \not\subseteq \overline{a} \cup q \)

**Quantity violation**

For some \( Q' \subseteq Q \), \( s \subseteq \bigcup Q' \) and \( \bigcup R \not\subseteq \bigcup Q' \).
6.3. General results

My approach unifies existing approaches:
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My approach unifies existing approaches:

- Quality: ‘lack of belief in proposition expressed’
  (Truckenbrodt, 2006)

- Relation: ‘uncertain relevance’/‘scalar uncertainty’
  (Ward & Hirschberg, 1985)

- Relation: ‘rise-fall-rise quantifies over focus alternatives’
  (Constant, 2012)

- Quantity: ‘unfinishedness’ (Bartels, 1999)

- Manner reading: Usually treated as a side-effect.

The enabling innovation is the ‘attentive’ maxim of Relation.
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The enabling innovation is the ‘attentive’ maxim of Relation.
7. Discussion

7.1. Evoked questions
7.2. Other uses of the rise
7.3. Objective/subjective cooperativity
7.1. Evoked questions

- Conveying uncertainty regarding $\phi$ typically *evokes the question* of whether $\phi$. 
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(4) Did John go to the party?
It was raining ↙.
\( \sim \) He \{likes / dislikes\} rainy parties
7.1. Evoked questions

- Conveying uncertainty regarding $\phi$ typically evokes the question of whether $\phi$.
- Hence, the Quality, Relation and Manner readings evoke questions!

(4) Did John go to the party?

It was raining ↓. $\leadsto$ He \{likes / dislikes\} rainy parties

It was raining ↑\(^L\). $\leadsto$ Does he like rainy parties?
7.1. Evoked questions

- Conveying uncertainty regarding φ typically *evokes the question* of whether φ.
- Hence, the Quality, Relation and Manner readings evoke questions!

\[ (4) \] Did John go to the party?
- It was raining ↘.
  \[ \sim \] He \{likes / dislikes\} rainy parties
- It was raining ↗\textsubscript{L}.
  \[ \sim \] *Does he like rainy parties?*
- He only likes rainy parties ↗\textsubscript{L}?
  \[ \sim \] *Was it raining?*

Connecting this to the literature is a work in progress.
7.1. Evoked questions

- Conveying uncertainty regarding $\phi$ typically evokes the question of whether $\phi$.
- Hence, the Quality, Relation and Manner readings evoke questions!

(4) Did John go to the party?

- It was raining $\downarrow$. $\sim$ He $\{\text{likes} / \text{dislikes}\}$ rainy parties
- It was raining $\uparrow^L$. $\sim$ Does he like rainy parties?
- He only likes rainy parties $\uparrow^L$? $\sim$ Was it raining?

Connecting this to the literature is a work in progress.
7.2. Other uses of the rise
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Contrastive topic (Büring, 2003):

(9) \([\text{John}]_{CT} \text{ had the } [\text{beans}]_F\).
7.2. Other uses of the rise

Contrastive topic (Büring, 2003):

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Contrastive topic (Büring, 2003):

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Interrogatives:

(10) a. Was John there $\rightarrow$?
   b. Was John there $\leftarrow$?
7.2. Other uses of the rise

Contrastive topic (Büring, 2003):

(9) \([\text{John}]_F \nearrow \) had the \([\text{beans}]_F \searrow \).

Interrogatives:

(10) a. Was John there \(\nearrow \)?
    b. Was John there \(\searrow \)?

Future work!
7.3. Objective/subjective cooperativity

The maxims can be (and have been) defined in two ways:

- **Objective**: Say only what is true, relevant, etc.
- **Subjective**: Say only what you think is true, relevant, etc.

My account of the final rise relies on subjective maxims:

- Violating 'say only what you think is true' = uncertainty
- Violating 'say only what is true' = lying

But an account based on objective maxims would also work:

- Final rise: 'For some maxim, I'm not sure whether or how I comply with it'.
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End of Part II
General conclusion
General conclusion

Part I:

- If pragmatic reasoning is sensitive to *attentive content*
General conclusion

Part I:

- If pragmatic reasoning is sensitive to *attentive content*
- then *exhaustivity is a conversational implicature.*
General conclusion

Part I:
  ▶ If pragmatic reasoning is sensitive to *attentive content*
  ▶ then *exhaustivity is a conversational implicature*.

Part II:
  ▶ If, furthermore, the final rise conveys the violation of a maxim
General conclusion

Part I:
  ▶ If pragmatic reasoning is sensitive to *attentive content*
  ▶ then *exhaustivity is a conversational implicature*.

Part II:
  ▶ If, furthermore, the final rise conveys the violation of a maxim
  ▶ then the many readings of the final rise are predicted.
The End

Articles

- *Exhaustivity through the maxim of Relation* (LENLS proceedings, see staff.science.uva.nl/~westera/)
- ‘Attention, I’m violating a maxim!’ (submitted, available through me)

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Appendix. ‘Embedded’ implicatures
Chierchia, *et al.* (2008), and much subsequent discussion

(6) Which books did every student read?
Every student read O. or K.L. \(\sim\) No student read both.
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The problem

The problem has never been the Gricean approach as such, but rather to find the right ‘alternatives’.
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In the present theory:

- The maxims are sensitive to attentive content
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The problem has never been the Gricean approach as such, but rather *to find the right ‘alternatives’.*

In the present theory:
- The maxims are sensitive to attentive content
- Attentive content mirrors sub-sentential structure.
- (Hence so do the ‘alternatives’.)
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Chierchia, et al. (2008), and much subsequent discussion

(6) Which books did every student read?
    Every student read O. or K.L. ∼ No student read both.

The problem
The problem has never been the Gricean approach as such, but rather to find the right ‘alternatives’.

In the present theory:
- The maxims are sensitive to attentive content
- Attentive content mirrors sub-sentential structure.
  (Hence so do the ‘alternatives’.)
The ‘embedded’ implicature of (6) is in fact predicted.
References (i)

References (ii)