Attentive *might* in inquisitive semantics

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Overview

- Two puzzles for the standard modal account of *might*
- Attentive *might* in inquisitive semantics
- Attentive *might* in inquisitive pragmatics
- Comparison with modal and dynamic accounts
Zimmermann’s (2000)
The following are all equivalent:

(1) John might be in London or in Paris. \( \Diamond(p \lor q) \)

(2) John might be in London or he might be in Paris. \( \Diamond p \lor \Diamond q \)

(3) John might be in London and he might be in Paris. \( \Diamond p \land \Diamond q \)
Puzzle 1: *might* meets disjunction and conjunction

Crucially

- *Might* behaves differently in this respect from clear-cut epistemic modals
- The following are clearly not equivalent:
  
  (4) It is consistent with my beliefs that John is in London or it is consistent with my beliefs that he is in Paris.
  
  (5) It is consistent with my beliefs that John is in London and it is consistent with my beliefs that he is in Paris.

- This is problematic if *might* is analyzed as an epistemic modal
Puzzle 1: *might* meets disjunction and conjunction

Further observation

- For the equivalence to go through, it is crucial that John cannot be both in London and in Paris at the same time

Szabolcsi’s scenario

- We need an English-French translator, i.e., someone who speaks *both* languages. In that context, (8) is perceived as a useful recommendation, while (6) and (7) are not.

(6) John might speak English or French. \( \Diamond (p \lor q) \)
(7) John might speak English or he might speak French. \( \Diamond p \lor \Diamond q \)
(8) John might speak English and he might speak French. \( \Diamond p \land \Diamond q \)
Puzzle 2: *might* meets negation

**Basic observation**
Standard sentential negation never takes scope over *might*

(9) John might not be in London. \(\diamond \neg p\)

**Crucially**

*Might* ≠ ‘it is consistent with my information that’

(10) It is not consistent with my information that John is in London. \(\neg \text{CONSISTENT } p\)
Main point

- The notion of meaning that we have in inquisitive semantics is designed to capture informative and inquisitive content.

- We will show here that it can be further refined in such a way that it does not only capture informative and inquisitive content, but also a sentence’s potential to draw attention to certain possibilities.

- This allows for a novel analysis of *might*.
Driving intuition

(11) John might be in London.
(12) John is in London.
(13) Is John in London?

Main contrasts

• (11) differs from (12) in that it does not provide the information that John is in London
• (11) differs from (13) in that it does not request information
• ‘ok’ is an appropriate response to (11) but not to (13)

Main intuition

• The semantic contribution of (11) lies in its potential to draw attention to the possibility that John is in London
Let’s refer to a set of possible worlds as a possibility. Then the notion of a proposition as a set of possibilities is ideally suited to capture attentive content. We can simply think of a sentence $\varphi$ as drawing attention to all the possibilities in $[\varphi]$. At the same time, we can still think of $[\varphi]$ as capturing the informative and inquisitive content of $\varphi$, just as before. Hence, informative, inquisitive, and attentive content are all captured by a single semantic object.
A propositional language

Basic ingredients

- Finite set of atomic sentences $\mathcal{A}$
- Connectives $\neg$, $\land$, $\lor$, $\diamond$

Question and assertion operators

- $!\varphi := \varphi \lor \neg \neg \varphi$
- $?\varphi := !\varphi \lor \neg \varphi$
Worlds, possibilities, and propositions

- **Possible worlds**: functions from $A$ to $\{0, 1\}$
- **Possibilities**: sets of possible worlds
- **Propositions**: non-empty sets of possibilities

Illustration
Propositions do not have to be downward closed

- In InqB propositions were defined as non-empty downward closed sets of states/possibilities.

- This was because the possibilities in a proposition \([\varphi]\) were taken to correspond to pieces of information that settled the issue embodied by \([\varphi]\).

- If a possibility \(\alpha\) settles a given issue, then clearly every \(\beta \subseteq \alpha\) must settle the issue as well.

- That’s why propositions had to be downward closed in InqB.
Propositions do not have to be downward closed

• This is appropriate if we are only interested in informative and inquisitive content

• But if we want to model attentive content as well, propositions have to be arbitrary non-empty sets of possibilities

• In uttering a sentence, a speaker may very well draw attention to a certain possibility $\alpha$ without drawing attention to any $\beta \subseteq \alpha$
We will consider here a simple system that solves the puzzles we started out with
(from Ciardelli, Groenendijk and Roelofsen, SALT 2009)

However, the system presented here has some problems

We are still thinking about ways to avoid these problems
Atomic sentences

For any atomic sentence $p$:

$$[p] = \{ \{w \mid w(p) = 1\} \}$$

**Example:**

$$p$$

\begin{align*}
11 & \quad 10 \\
01 & \quad 00
\end{align*}
Negation

Definition

• \([-\varphi] = \bigcup [\varphi]\]

• Take the union of all the possibilities for \(\varphi\); then take the complement

Example, \(\varphi\) classical:

\[
\begin{array}{cc}
11 & 10 \\
01 & 00 \\
\end{array}
\]

\([p]\)

\[
\begin{array}{cc}
11 & 10 \\
01 & 00 \\
\end{array}
\]

\([-p]\)
Negation

Definition

- $\neg \varphi = \{ \bigcup [\varphi] \}$

- Take the union of all the possibilities for $\varphi$; then take the complement

Example, $\varphi$ inquisitive:
Disjunction

Definition

- \([\varphi \lor \psi] = [\varphi] \cup [\psi]\)

Examples:

\[
\begin{array}{c|c|c|c|c|}
1 & 1 & 0 & 1 & 1 \\
0 & 1 & 0 & 0 & 0 \\
\end{array}
\]

\(p \lor q\)

\[
\begin{array}{c|c|c|c|c|}
1 & 1 & 0 & 1 & 1 \\
0 & 1 & 0 & 0 & 0 \\
\end{array}
\]

\(?p \ (= p \lor \neg p)\)
Conjunction

Definition

- $[\varphi \land \psi] = \{\alpha \cap \beta \mid \alpha \in [\varphi] \text{ and } \beta \in [\psi]\}$

- Pointwise intersection

Example, $\varphi$ and $\psi$ classical:

\[
\begin{array}{c c c c}
11 & 10 & 11 & 10 \\
01 & 00 & 01 & 00 \\
p & q & p \land q
\end{array}
\]
Conjunction

Definition

- \([\varphi \land \psi] = \{\alpha \cap \beta \mid \alpha \in [\varphi] \text{ and } \beta \in [\psi]\}\)

- Pointwise intersection

Example, \(\varphi\) and \(\psi\) inquisitive:
Might

\[ [\Diamond \varphi] = [\varphi] \cup \{W\} \]

**Intuition:** \(\Diamond \varphi\) proposes exactly the same updates as \(\varphi\), but also offers the option to keep the common ground just as it is

**Examples**

- \(\Diamond p\)
- \(\Diamond (p \land q)\)
- \(\Diamond (p \lor q)\)
In uttering a sentence $\varphi$, a speaker:

1. **draws attention** to all the possibilities in $[\varphi]$
2. **provides the information** that the actual world is located in at least one of the possibilities in $[\varphi]$
3. **requests information** from other participants to locate the actual world more precisely in a specific possibility in $[\varphi]$
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$\Rightarrow$ a single semantic object embodies informative, inquisitive, and attentive content
Inquisitive content

- \( \varphi \) requests a response that provides enough information to locate the actual world in a specific possibility in \([\varphi]\).
- Sometimes, it suffices to accept the information that \( \varphi \) itself already already provides.
- If additional information is required, we call \( \varphi \) inquisitive.
Alternative and residual possibilities

Three possibilities:
\[
\begin{align*}
\alpha &= \{w_1, w_2\} \\
\beta &= \{w_1, w_3\} \\
\gamma &= \{w_1\}
\end{align*}
\]

- Providing the information that at least one of \{\alpha, \beta, \gamma\} contains the actual world is the same as providing the information that at least one of \{\alpha, \beta\} contains the actual world.
- Requesting a response that establishes at least one of \{\alpha, \beta, \gamma\} is the same as requesting a response that establishes at least one of \{\alpha, \beta\}.
- So \gamma does not play a role in determining the informative or inquisitive content of this proposition.
Three possibilities:

\[ \alpha = \{w_1, w_2\} \]
\[ \beta = \{w_1, w_3\} \]
\[ \gamma = \{w_1\} \]

- In general, for any proposition \([\varphi]\), we can distinguish:
  
  - **Alternative possibilities**
    
    - not properly contained in a maximal possibility in \([\varphi]\)
    
    - completely determine the informative & inquisitive content of \(\varphi\)
  
  - **Residual possibilities**
    
    - properly contained in a maximal possibility in \([\varphi]\)
    
    - only play a role in capturing the attentive content of \(\varphi\)
Inquisitive, informative, and attentive sentences

Definitions

- $\varphi$ is informative iff it eliminates at least one world, i.e., $\bigcup [\varphi] \neq W$
- $\varphi$ is inquisitive iff $[\varphi]$ contains at least two alternative possibilities
- $\varphi$ is attentive iff $[\varphi]$ contains at least one residual possibility

Example

- $p \lor q \lor (p \land q)$ “$p$ or $q$ or both”
  informative, inquisitive, and attentive
Questions, Assertions, and Conjectures

Definitions

• $\varphi$ is a question iff it is neither informative nor attentive
• $\varphi$ is an assertion iff it is neither inquisitive nor attentive
• $\varphi$ is a conjecture iff it is neither informative nor inquisitive

Examples

\[
\begin{array}{cc}
11 & 10 \\
01 & 00 \\
\end{array}
\]


\[
\begin{array}{cc}
11 & 10 \\
01 & 00 \\
\end{array}
\]


\[
\begin{array}{cc}
11 & 10 \\
01 & 00 \\
\end{array}
\]

$?p$

$p$

$\Diamond p$
Every *might* sentence is a conjecture

- ♦φ is never informative
- ♦φ is never inquisitive
- So ♦φ is always a conjecture

Every conjecture can be expressed by a *might* sentence

- φ is a conjecture if and only if φ ≡ ♦φ
Closure properties of conjectures

For any $\varphi$ and $\psi$:

- $\Diamond \varphi$ is a conjecture;
- if $\varphi$ and $\psi$ are conjectures, then so is $\varphi \land \psi$;
- if at least one of $\varphi$ and $\psi$ is a conjecture, so is $\varphi \lor \psi$;

Examples

(14) John might be in London. \quad \Diamond p
(15) John might be in London and Bill in Paris. \quad \Diamond p \land \Diamond q
(16) John is in London, or he might be in Paris. \quad p \lor \Diamond q
"Might" meets disjunction and conjunction

Zimmermann’s (2000)
The following are all equivalent:

1. John might be in London or in Paris. \( \Diamond (p \lor q) \)
2. John might be in London or he might be in Paris. \( \Diamond p \lor \Diamond q \)
3. John might be in London and he might be in Paris. \( \Diamond p \land \Diamond q \)
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Further observation

- For the equivalence to go through, it is crucial that John cannot be both in London and in Paris at the same time.

Szabolcsi’s scenario

- We need an English-French translator, i.e., someone who speaks both languages. In that context, (8) is perceived as a useful recommendation, while (6) and (7) are not.

(6) John might speak English or French. \( \Diamond (p \lor q) \)
(7) John might speak English or he might speak French. \( \Diamond p \lor \Diamond q \)
(8) John might speak English and he might speak French. \( \Diamond p \land \Diamond q \)
Might meets disjunction and conjunction

Whenever the disjuncts are mutually exclusive, as in (c), all three sentences are indeed equivalent.

If the disjuncts are not mutually exclusive, then $\diamond p \land \diamond q$ differs from the other two in that it draws attention to the possibility that $p$ and $q$ both hold.

This is what makes $\diamond p \land \diamond q$ a useful recommendation in Szabolcsi’s scenario.
**Might meets negation**

**Basic observation**
Standard sentential negation never takes scope over *might*

(17) John might not be in London. \(\Diamond \neg p\)

**Crucially**

*Might* ≠ ‘it is consistent with my information that’

(18) It is not consistent with my information that John is in London. \(\neg \text{CONSISTENT } p\)

**Explanation**

\(\neg \Diamond \varphi\) is always a contradiction

See the paper for similar, but more complex effects in conditionals
Projection operators

Issues

[?] A

[?] A

[!] A

[!] A

Attention

[?◊] A

[?!] A

[◊] A

[!◊] A

Information
Projections onto the axes

[?]A purely inquisitive projection
[!]A purely informative projection
[◇]A purely attentive projection
Projections onto the planes

Issues

Attention

Information

[?◊]A  non-informative projection
[?!]A  non-inquisitive projection
[?!]A  non-attentive projection
Example: purely informative projection

Requirements

- \([!]A\) should **preserve the informative content of** \(A\)
- \([!]A\) should be **non-inquisitive**
- \([!]A\) should be **non-attentive**

Implementation

- \([!]A = \{\bigcup A\}\)
Another example: non-inquisitive projection

Requirements

- [$!]\Diamond A$ should **preserve** the informative content of $A$
- [$!]\Diamond A$ should be **non-inquisitive**
- [$!]\Diamond A$ should **preserve** the attentive content of $A$

Implementation

- [$!]\Diamond A = A \cup \{\bigcup A\}$

![Diagram showing the implementation of non-inquisitive projection]
Relevance for natural language semantics

• It makes sense to think of declarative complementizers as non-inquisitive closure operators

Example:

(19)  \( C_D \) John speaks Russian or French.

• Informative and attentive, but not inquisitive
• Alternatives introduced by disjunction, but closed off by \( C_D \)
Gricean pragmatics generally assumes a truth-conditional semantics, which captures only informative content.

Gricean pragmatics is a pragmatics of providing information.

Inquisitive semantics enriches the notion of semantic meaning.

This requires an enrichment of the pragmatics as well.

We need not just a pragmatics of providing information, but rather a pragmatics of exchanging information.
Inquisitive pragmatics (sketch)

Quality
Maintain the common ground and your own information state.

• Be sincere (speaker oriented)
  • Only assert what you take yourself to know
  • Only ask what you don’t know
  • Only draw attention to ‘live’ possibilities

• Be transparent: signal inconsistency (hearer oriented)
  Reject a proposed possibility if it is inconsistent with your information state
Inquisitive pragmatics (sketch)

Relatedness/compliance

- The semantics allows us to formulate several formal notions of relatedness/compliance

Quantity

- Among all the compliant and sincere responses to a given (possibly implicit) question under discussion, there is a general preference for more informative responses
(11) John might be in London.

Possibility

• (11) signals that the speaker considers it possible that John is in London

⇒ point of departure for a modal analysis of *might*
(11) John might be in London.

Consistency test

• (11) imposes a consistency test on the hearer: if her information state is inconsistent with John being in London, she must report this

⇒ point of departure for Veltman’s update semantics of *might*
Back to *might*: three basic observations

(11) John might be in London.

Ignorance

- (11) typically signals that the speaker is ignorant as to whether John is in London or not
  - typically analyzed as a Gricean implicature
The inquisitive account

(11)  John might be in London.

Possibility

• (11) signals that the speaker considers it possible that John is in London

• Follows directly from sincerity

• Unlike the modal analysis, this account directly extends to:

(1)  John might be in London or in Paris.
The inquisitive account

(11) John might be in London.

Consistency test

- (11) imposes a consistency test on the hearer: if her information state is inconsistent with John being in London, she must report this.
- Follows directly from transparency.
- Unlike update semantics, this account directly extends to:

(1) John might be in London or in Paris.
The inquisitive account

(11) John might be in London.

Ignorance

• (11) typically signals that the speaker is ignorant as to whether John is in London or not
• Follows from the quantitative preference for more informative compliant moves
Division of labor

Semantics

• Specifies which proposals are expressed by which sentences

Pragmatics

• Specifies what a context—in particular, the common ground and the speaker’s information state—must be like in order for a certain proposal to be made
• ... and how a hearer is supposed to react to a given proposal, depending on the common ground and her own information state.
The idea that the core semantic contribution of \( \textit{might}\)-\( \varphi \) lies in its potential to draw attention to certain possibilities has been entertained before.

For instance, Groenendijk, Stokhof, and Veltman (1996) write:

\begin{quote}
\textit{in many cases, a sentence of the form might-\( \varphi \) will have the effect that one becomes aware of the possibility of \( \varphi \).}
\end{quote}

Similar ideas can be found in more recent work:

e.g. Swanson (2006), Franke and de Jager (2008), Brumwell (2009), Dekker (2009).

Related ideas exist also in the literature on evidentials (Murray, 2010; Faller, 2002).
Final remarks

- However, Groenendijk, Stokhof, and Veltman continue to point out that their framework

  “is one in which possible worlds are total objects, and in which growth of information about the world is explicated in terms of elimination of worlds. Becoming aware of a possibility cannot be accounted for in a natural fashion in such an eliminative approach. It would amount to extending partial worlds, rather than eliminating total ones. To account for that aspect of the meaning of might a constructive approach seems to be called for.”
Final remarks

- We have taken a different route
- Possible worlds are still total objects
- Growth of information still amounts to eliminating worlds
- What has changed is the very notion of meaning
- No truth-conditions, no information change potential, but rather information exchange potential
- This shift in perspective immediately facilitates a perspicuous account of might, and of attentive content more generally
Appendix: some open issues

• Conjunction
• Implication
• Entailment
Conjunction

Conjunction as pointwise intersection

- \([\varphi \land \psi] = \{ \alpha \cap \beta \mid \alpha \in [\varphi] \text{ and } \beta \in [\psi] \}\)

Is not idempotent

- \((p \lor q) \land (p \lor q) \neq p \lor q\)
- \((p \lor q) \land (p \lor q) \equiv p \lor q \lor (p \land q)\)
• Note that we did not specify a notion of entailment in the paper

• Entailment should not only take informative and inquisitive content into account in this setting, but also attentive content

• When we wrote the paper we had no clear idea about attentive entailment

• Now we do have some ideas, but none of them is really conclusive
Implication

• In terms of support, there is a reasonable clause for implication

• We also have an algebraic of characterization of implication in the support-based system, as relative pseudo-complementation

• With attentive content on board, it is less clear how we should think about implication

• As long as we do not have a notion of entailment, the algebraic approach does not get off the ground

• And even if it does, it is likely that we cannot treat implication as relative pseudo-complementation in this setting