Might as a generator of alternatives the view from reasoning

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1. Background

- Recent efforts to seek convergence between NL semantics and the psychology of reasoning have led to articulated theories of interpretive processes and general-purpose reasoning.

Erotetic theory of reasoning (Koralus & Mascarenhas, 2013)
- Reasoning is partly about questions and answers.
- Some sentences raise questions in the sense of inquisitive semantics (Groenendijk, 2008; Mascarenhas, 2009).
- Pressure to reduce the number of alternatives under consideration as soon as possible generates fallacies.

- This theoretical work has brought to light a host of new **illusory inferences**.

(1) John speaks English and Mary speaks French, or else Bill speaks German.
John speaks English.
Fallacious conclusion: Mary speaks French.

(2) Some pilot writes poems.
John is a pilot.
Fallacious conclusion: John writes poems.

2. Current study

- We give arguments from reasoning in favor of the idea of *might* as a generator of alternatives. In the process we demonstrate the great potential of articulated theories of interpretation and reasoning: semantically informed theories of reasoning make better predictions, and reasoning tasks can serve as diagnostics for narrowly semantic properties.
- Ciardelli et al. (2009): *Might* generates a single alternative in the sense of Hamblin semantics or inquisitive semantics.

Comparison	Wilcoxon	p-value
(A)	$V = 674$	$p < 0.01$
(B)	$W = 256.5$	$p < 0.001$
(C)	$W = 281$	$p < 0.001$
(D)	$W = 533.5$	$p > 0.8$

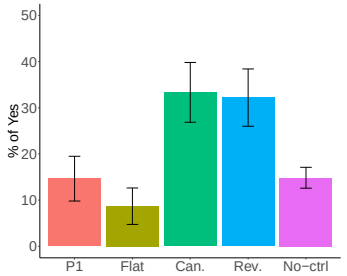

Figure 1: Left: statistics; right: yes-responses by inference type, with SEM.

- This semantics + ETR predict novel illusory inferences.

(3) Miranda might play the piano and be afraid of spiders.
Miranda plays the piano.
Fallacious conclusion: Miranda is afraid of spiders.

- But not for this plausibly discourse equivalent example:

(4) Miranda plays the piano and might be afraid of spiders.
Fallacious conclusion: Miranda is afraid of spiders.

2.1. Design

- 210 participants on Amazon MechanicalTurk; 66% female, from 18 to 74 y.o. ($\mu = 36$, $\sigma = 11.4$).
- 18 reasoning problems to solve:
  - 6 controls, valid and invalid *modus ponens*
  - 8 targets of only one of the four following types

(5)
a. Canonical $might(a \wedge b), a \vdash b$
b. P1 $might(a \wedge b) \vdash b$
c. Flat $a \wedge might(b) \vdash b$
d. Reversed $a, might(a \wedge b) \vdash b$

2.2. Results

- (A) *Might* triggers an illusory inference (can. & rev. vs. no-controls) ✓
- (B) not because of *might* alone (can. & rev. vs. P1) ✓
- (C) but because something erotetic happens (can. & rev. vs. flat) ✓
- (D) we did not detect an order effect (can. vs. rev.) ✗

3. Articulating semantics of 'might' and theories of reasoning

3.1. Inquisitive semantics and the erotetic theory of reasoning

- Ciardelli et al. (2009): $might(\varphi) \Leftrightarrow \varphi \vee \top$
- Feeding this interpretation into ETR derives the fallacy.

$$\{0\}[\{a \sqcup b, 0\}]^{\mathsf{Up}} = \{a \sqcup b, 0\} \quad \text{Updating a blank state with } might(a \wedge b)$$
$$[\{a\}]^{\mathsf{Up}} = \{a \sqcup b\} \quad \text{Keeping alternatives } \gamma \text{ only if } \gamma \sqcap a \neq \emptyset$$
$$[\{b\}]^{\mathsf{MR}} = \{b\} \quad \text{Checking if } b \text{ is an answer}$$

- We can formulate the erotetic process in terms of hypothesis testing:
  1. The first premise provides a *hypothesis* to test: $a \wedge b$.
  2. The second premise a provides some *evidence*.
  3. The evidence *confirms* the hypothesis (e.g. Bayesian confirmation theory), so the hypothesis is taken to follow.

3.2. Scalar implicatures

- To explain away the fallacy as a scalar implicature, we would need to strengthen the first premise into:

$$\Diamond(a \wedge b) \wedge \neg\Diamond(a \wedge \neg b) \Leftrightarrow \Diamond(a \wedge b) \wedge \Box(a \rightarrow b)$$

- This is not an intuitive inference from *might*.
- To our knowledge, no theory of scalar implicature derives it.

3.3. Relational semantics

- Kratzer (1991): $might(\varphi)$ is true iff **there is** a φ-world among the best ranked worlds
- With the following assumptions:
  - When asserting a proposition φ, a speaker says that φ is true in the actual world.
  - The modal base is reflexive.
  - The existential quantifier in the lexical entry for *might* is inquisitive.
  - Reasoning is erotetic.
- We can derive the fallacy:
  - The first premise $might(a \wedge b)$ asks "which best-ranked $a \wedge b$-world are we talking about?"
  - The second premise says "the actual world is an a-world."
  - Erotetic mechanisms predict a conclusion of "the actual world is a best-ranked $a \wedge b$-world!"

3.4. Conjunction is not enough

- Does **just any** non-asserted conjunction $a \wedge b$ imply $a \leftrightarrow b$?
- No: in a related study (in progress) we looked at antecedents and consequents of conditionals (1) *if* $a \wedge b$ *then* c; (2) *if* c *then* $a \wedge b$.
- We found no fallacy for antecedents (1), although there was an effect for consequents (2).

3.5. Probabilistic semantics

- Oaksford and Chater (2007): reasoners accept φ on the grounds of Γ only if $P(\varphi|\Gamma) > \tau$
- Lassiter (2016): $might(\varphi)$ is true iff $P(\varphi) > \theta$
- Combining these, we obtain the following acceptance conditions per inference type:

$$\text{Canonical} \quad P(b|a \;\&\; P(a \wedge b) > \theta) > \tau$$
$$\text{Reversed} \quad P(b|a \;\&\; P(a \wedge b) > \theta) > \tau$$
$$\text{Flat} \quad P(b|a \;\&\; P(b) > \theta) > \tau$$

- The probabilistic semantics predicts:
  - no difference between canonical and reversed ✓
  - Flat no less attractive than Canonical, because $P(b) \geq P(a \wedge b)$ ✗

4. Conclusions

- *Might* triggers illusory inferences because it is a generator of alternatives.
- Reasoning can diagnose semantic alternatives.
- Every extant theory of *might* needs to be extended to account for these facts, but some more than others.

https://bit.ly/2VxSLjr

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