What if s

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(Joint work with Justin Bledin, JHU Philosophy.)
Conditionals at the crossroads
11th November, 2016, University of Konstanz
Hypothetical *what if*s

(1) What if Napolean had won at Waterloo?
(2) A: What if cats could text?
Hypothetical *what if*s

(1) What if Napoleon had won at Waterloo?

(2) A: What if cats could text?
    B: They’d be constantly messaging about food.
    B: They’d demand even more attention.
Hypothetical *what ifs*

(1)  What if Napoleon had won at Waterloo?

(2)  A:  What if cats could text?

B:  They’d be constantly messaging about food.

B:  They’d demand even more attention.

The internet provides:

![Image of SMS conversation]

- Come home. There's an emergency.
- What?? Are you ok?
- My food bowl is half empty.
- I'll be home soon.
- You wish starvation upon me.
- Stop being so dramatic.
- Am weak. Can hardly type.
- Goodbye.
Hypothetical *what if*s

Many examples on XKCD’s ‘what if’ site:

(3)  
  a. What if I tried to re-enter the atmosphere in my car? (a 2000 VW Jetta TDI).
  
  b. What if you built a siphon from the oceans on Europa to Earth? Would it flow once it’s set up?
Hypothetical *what ifs*

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Intuition
What would the world be like if...?
Key points

• Data: ‘what if’s are extremely flexible and often used for much more specific questions.

• Compare ‘what if’s to conditional questions (Rawlins 2010b,a).

• New proposal: ‘what if’s are purely suppositional questions that rely on an existing ‘Question Under Discussion’ (QUD; Roberts 1996, Ginzburg 1996) in context.

• Will need to generalize the notion of QUD a bit.
Hypothetical flexibility

‘What if’ syntax

‘What if’s as suppositional questions

Generalizing to decision problems

Conclusions
Hypothetical flexibility
Challenging *what ifs*

(Rawlins 2010a: *Conversational Backoff*)

(4)  
A: I’m not going to go the party.  
B: What if Joanna is there? (Are you sure?)
Challenging *what ifs*

(Rawlins 2010a: *Conversational Backoff*)

(4) A: I’m not going to go the party.  
B: What if Joanna is there? (Are you sure?)

(5) The boy came right over and boldly proposed that, since they were both there at the same time every week, they could start sharing a paper and save a tree. “*What if we both want the same section?*” Pip said with some hostility. (COCA)

(6) “If I can’t talk to you without feeling played, I’ve got to go for the gun.” “*What if you don’t have a gun?*,” I asked. (COCA)
(Rawlins 2010a: Conversational Backoff)

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(7) “Push it open, then step away.” “What if it’s locked?” Peggy said.

(8) “Hey, maybe the squirrel is underneath those trash bags. Stir it up a bit.” “Not funny, what if it attacks?” (COCA)
Challenging *what ifs*

- Respond to an assertion (or other informational contribution), imperative.
- Cross-speaker.
- Prevent acceptance of a claim. (Rawlins 2010a: conversational backoff)
(9) I heard that Alfonso’s going to the party – what if Joanna is there?

(10) A: Alfonso’s going to the party.
     B: Uh oh, what if Alfonso’s there?
(9) I heard that Alfonso’s going to the party – what if Joanna is there?

(10) A: Alfonso’s going to the party.  
     B: Uh oh, what if Alfonso’s there?

(11) Is Alfonso going to the party? What if Joanna is there?

(12) Now there’s just a VW between Adam and her. What if he sees her? (COCA; narrative text)
Consequential *what ifs*

- Respond to an accepted assertion (or other informational contribution).
- Same-speaker or cross-speaker.
- Ask about consequences of some information.
(13) A: How do I get to Konstanz?
B: What if you fly to Zurich?

(14) A: Who should we invite to give a talk?
B: What if we invite Joanna?

(15) A: Who could possibly be the murderer?
B: What if the butler lied about his alibi?
Suggestive *what ifs*

- Respond to a question that is either:
  1. A ‘planning’ question, or a question with collaborative planning in the background.
  2. A ‘collaborative brainstorming’ question.
- Typically cross-speaker.
- Offer a suggested resolution of some question.
### Summary: four *what if*s

<table>
<thead>
<tr>
<th>Type / function</th>
<th>antecedent</th>
<th>antecedent speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothetical (‘stoner’ question)</td>
<td>none</td>
<td>N/A</td>
</tr>
<tr>
<td>Challenging (‘but have you considered?’)</td>
<td>informational</td>
<td>cross</td>
</tr>
<tr>
<td>Consequential (‘what would happen if’)</td>
<td>informational question</td>
<td>cross/same</td>
</tr>
<tr>
<td>Suggestive (‘how about...’)</td>
<td>informational question</td>
<td>cross</td>
</tr>
</tbody>
</table>

How to capture all this??
‘What if’ syntax
Idiosyncratic ‘what’

Restricted to just ‘what’:

(16) What if we invite Joanna?

(17) *{who, when, how, why, where} if we invite Joanna?
Idiosyncratic ‘what’

Restricted to just ‘what’:

(16) What if we invite Joanna?

(17) *{who, when, how, why, where} if we invite Joanna?

Compare:

(18) {What, how} about if we invite Joanna?

(19) *{Who, when, why, where} about if we invite Joanna?
‘What’ can’t undergo normal modification:

(20)  a.  *What else if we invite Joanna?
    b.  *What the hell if we invite Joanna?

(21)  a.  What else would happen if we invite Joanna?
    b.  What the hell would happen if we invite Joanna?
The ‘if’-clause, externally

Only if conditionals (von Fintel 1994, Herburger, a.o.)

(22) What would happen only if we invite Joanna?
(23) *What only if we invite Joanna?
The ‘if’-clause, externally

**Only if** conditionals (von Fintel 1994, Herburger, a.o.)

(22) What would happen only if we invite Joanna?

(23) *What only if we invite Joanna?

**Unconditionals** (Rawlins 2013 a.o.)

(24) What would happen whether or not we invite Joanna?

(25) *What whether or not we invite Joanna?
The ‘if’-clause, externally

Only if conditionals (von Fintel 1994, Herburger, a.o.)

(22)  What would happen only if we invite Joanna?
(23)  *What only if we invite Joanna?

Unconditionals (Rawlins 2013 a.o.)

(24)  What would happen whether or not we invite Joanna?
(25)  *What whether or not we invite Joanna?

Other complementizers:

(26)  *What when a farmer owns a donkey?
(27)  *What if and when we invite Joanna?
The ‘if’-clause, externally

An ‘if’-clause is required:

(28) Suppose we invite Joanna. *What?

Compare:

(29) a. Suppose we invite Joanna. Then what?
    b. Suppose we invite Joanna. What would happen?
    c. If we invite Joanna, then what? (n.b. different meaning than ‘what if’)

(Not to say that bare ‘what??’ doesn’t have its uses.)
The ‘if’-clause, internally

The internals of the ‘if’-clause are characteristic of ‘if’-clause adjuncts.

Counterfactuals, subjunctive:

(30) What if it {had snowed / were to snow}?
The ‘if’-clause, internally

The internals of the ‘if’-clause are characteristic of ‘if’-clause adjuncts.

Counterfactuals, subjunctive:

(30)  What if it {had snowed / were to snow}?


(31)  a. If Peter left in time, he would be in Frankfurt this evening. (Schulz 1-b)

b. How could Peter get to Frankfurt this evening?
   What if he left by two?

(32)  What if you flew to Zurich?
Unembeddable:

(33)  a. *Alfonso wondered what if it rained.
    b. Alfonso wondered, ‘what if it rained?’
    c. Alfonso wondered what would happen if it rained.
What to make of all this?

1. ‘What if’ s are questions (they license answers).
2. ‘What if’ s are syntactically root-clause-sized idiom chunks. (Speculation: ‘what’ realizes interrogative marking?)
3. The internals of the ‘if’ -clause appear as normal TP syntax.
4. The ‘what if’ sub-sequence is completely fixed.
5. ‘What if’ s are iffy.
‘What if’s as suppositional questions
‘What if’ questions are like conditional questions.
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- Rawlins (2010a): involve re-asking the QUD under a supposition. E.g ‘what if $\phi$’:
  
  “Suppose $\phi$. Then how is the QUD resolved?”

New proposal: they simply pose a question by introducing a supposition. Just: “Suppose $\phi$?


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Sketch of the proposal

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  “Suppose $\phi$. Then how is the QUD resolved?”

• New proposal: they simply pose a question by introducing a supposition. Just: “Suppose $\phi$?


First target: conditional questions

Where $c$ is a context, how to interpret: (Isaacs & Rawlins 2008)

$$c + \neg \text{if } \phi, \psi? \neg =$$
$$c + \neg \text{Assume}(\phi) \neg + \neg \text{Question}(\psi) \neg$$

Let an issue be a set of propositions. (Hamblin 1973)
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A context $c$ is a tuple $\langle cs_c, v_c, Q_c \rangle$:

a. $cs_c$ is a set of worlds (the context set).

b. $v_c$ is a set of worlds (the view).

c. $Q_c$ is a stack of issues (the topic stack).
(34) Let an issue be a set of propositions. (Hamblin 1973)

(35) **Contexts** A context $c$ is a tuple $\langle cs_c, v_c, Q_c \rangle$:

a. $cs_c$ is a set of worlds (the context set).

b. $v_c$ is a set of worlds (the view).

c. $Q_c$ is a stack of issues (the topic stack).

$cs_c$: straightforward Stalnakerian context set.

$v_c$: a temporary window onto part of the context set.

$Q_c$: a QUD stack in the style of Roberts (1996).
Utility updates

Where $c$ is a context:

(36) \[ c + \Gamma \text{Pop} \ = \ \langle cs_c, w, Q_c \rangle \] \hspace{1cm} \text{(clear the view)}

(37) \[ c + \Gamma \text{Dispel} \ = \ \langle cs_c, v, \text{pop}(Q_c) \rangle \] \hspace{1cm} \text{(dispel a topic)}

defined only if $Q_c \neq \langle \rangle$

- These don’t directly correspond to any particular linguistic form or move.
Informative update

(38) **Domain-restricted veridical update**: Where $cs$ and $v$ are sets of worlds, $cs \oplus_v \neg \phi = (cs - v) \cup (cs \cap v \cap \llbracket \phi \rrbracket)$.

(Cf. support in Kaufmann 2000, percolation in Isaacs & Rawlins 2008.)
Fact: if $cs \subseteq v$, then $cs \oplus v \downarrow \phi \uparrow = cs \cap [\phi]$. In other words, informative updates for $\langle cs, W, Q \rangle$ behave as standard Stalnakerian updates.
(39) **Fact:** if $cs \subseteq v$, then $cs \oplus_v \neg \phi = cs \cap [\phi]$.

In other words, informative updates for $\langle cs, W, Q \rangle$ behave as standard Stalnakerian updates.

(40) **Assertion:** where $c$ is a context,

$$c + \neg \text{Assert}(\phi) = \langle cs_c \oplus_{v_c} \neg \phi, v_c, Q_c \rangle$$

- Because of the previous fact, if $v_c = W$, this is just a standard Stalnakerian update.
Assumptions

\[(41) \quad c + \neg \text{Assume}(\phi) \triangleright = \langle cs_c, v_c \cap \llbracket \phi \rrbracket, Q_c \rangle \]
defined only if \(cs_c \cap v_c \cap \llbracket \phi \rrbracket \neq \emptyset\)

- The effect of subsequent assertions is constrained to only impact a subset of the context set.
Questions: semantics

I will assume that interrogative denotations are compositionally constructed as alternative sets in the style of Hamblin (1973), Kratzer & Shimoyama (2002).

• Polar questions are singleton sets: (Biezma & Rawlins 2012)
  
  \[ [\text{Is it raining?}] = \{ \lambda w_s . \text{it is raining in } w \} \]

• Alternative questions are the union of the disjuncts:
  
  \[ [\text{Is it raining}\uparrow \text{ or snowing}\downarrow?] = \{ \lambda w_s . \text{it is raining in } w, \lambda w_s . \text{it is snowing in } w \} \]

• Constituent questions are constructed pointwise based on the wh-item.
  
  \[ [\text{What’s the weather like?}] = \{ \lambda w_s . \text{raining in } w, \lambda w_s . \text{snowing in } w, \lambda w_s . \text{sunny in } w, \ldots \} \]
Roberts (1996):

(42) A partial answer to a question q is a proposition which contextually entails the evaluation – either true or false – of at least one element of q’s alternative set.

(43) A complete answer to a question q is a proposition which contextually entails the evaluation for all of q’s alternative set.

(Where p contextually entails p′ in context c ⊆ W just in case p ∩ c entails p′.)

I will implement this in a dynamic setting.
Questioning is simply putting a question on the topic stack:

\[(44) \quad \text{Questioning} \]
\[
c' = c + \lnot \text{Question}_a(\phi) = \langle cs_c, v_c, \text{push}(Q_c, [\phi]) \rangle
\]

Felicity conditions: appropriate in \( c \) only if

a. \( c' \) is inquisitive (details TBD),

b. \( \text{top}(Q_{c'}) \) is relevant (details TBD), and

c. \( a \) can’t resolve \( \text{top}(Q_{c'}) \) (details TBD).
The present system makes a distinction between a question as the topic of discourse, and the QUD at a particular context.

What do I mean by that?
Topics are interpreted through the lens of the current context.

- I will do this in a somewhat complicated way. **Payoff**: clarify two distinct aspects of ‘QUD’s.

Not the only way to implement the core idea. Subjects matters represent exclusive alternative sets.
Topics are interpreted through the lens of the current context.

Some useful utility functions.

(45) Where $p$ is a set of worlds, $\text{matter}(p) = \{ \langle w, v \rangle \mid w, v \in p \}$.

(46) Where $q$ is a subject matter, $\text{alts}(q) = \{ p \mid \forall w, v \in p : \langle w, v \rangle \in q \}$

(47) Where $q$ is a subject matter, $\text{inf}(q) = \{ w \mid \langle w, w \rangle \in q \}$
Topics are interpreted through the lens of the current context.

(48) **Polar QUDs**: Where $q$ is a subject matter and $p$ a proposition,

$$ q \ominus p = q \cap \{ \langle w, v \rangle | w \in p \leftrightarrow v \in p \} \quad \text{(Groenendijk 1999)} $$
Topics are interpreted through the lens of the current context.

(48) **Polar QUDs:** Where \( q \) is a subject matter and \( p \) a proposition,

\[
q \triangleq p = q \cap \{ \langle w, v \rangle | w \in p \leftrightarrow v \in p \}
\]

(Groenendijk 1999)

Suppose it’s raining in \( w_1, w_2 \), sunny in \( w_3 \), snowing in \( w_4 \).

\[
matter(\{w_1, w_2, w_3, w_4\}) \triangleq \{ w | \text{it’s raining in } w \}
\]

\[
\{ \langle w_1, w_1 \rangle, \langle w_1, w_2 \rangle, \\
\langle w_2, w_1 \rangle, \langle w_2, w_2 \rangle, \\
\langle w_3, w_3 \rangle, \langle w_3, w_4 \rangle, \\
\langle w_4, w_3 \rangle, \langle w_4, w_4 \rangle \}
\]
Topics are interpreted through the lens of the current context.

Generalize this to arbitrary sets of propositions:

\[ CQU^D(c) = \begin{cases} \cap \{ \text{matter}(cs_c \cap v_c) \otimes p \mid p \in \text{top}(Q_c) \} & \text{if } |Q_c| \geq 1 \\ \text{inq}(cs_c \cap v_c) & \text{otherwise} \end{cases} \]

The intersection of polar QUDs for every proposition \( \text{top}(Q_c) \).

- Intersection of equivalence relations is an equiv. relation.
- Can define relevance for assertions in terms of eliminating alternatives in the CQU^D.
Suppose it’s raining in $w_1, w_2$, sunny in $w_3$ and snowing in $w_4$.

What’s the weather like? $\mathbb{[}[\text{What’s the weather like?}] = \{\{w_1, w_2\}, \{w_3\}, \{w_4\}\}$. 

\[
\bigcap\{\{w_1, w_2, w_3, w_4\} \cap p \mid p \in \mathbb{[}[\text{what’s the weather like}]\}\} = \\
\left\{\begin{array}{c}
\langle w_1, w_1 \rangle, \quad \langle w_1, w_2 \rangle, \\
\langle w_2, w_1 \rangle, \quad \langle w_2, w_2 \rangle, \\
\langle w_3, w_3 \rangle, \quad \langle w_3, w_4 \rangle, \\
\langle w_4, w_3 \rangle, \quad \langle w_4, w_4 \rangle \\
\end{array} \right\} \\
\bigcap \\
\left\{\begin{array}{c}
\langle w_1, w_1 \rangle, \quad \langle w_1, w_2 \rangle, \\
\langle w_2, w_1 \rangle, \quad \langle w_2, w_2 \rangle, \\
\langle w_3, w_3 \rangle, \\
\langle w_4, w_1 \rangle, \quad \langle w_4, w_2 \rangle, \\
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\langle w_2, w_1 \rangle, \quad \langle w_2, w_2 \rangle, \quad \langle w_2, w_3 \rangle, \\
\langle w_3, w_1 \rangle, \quad \langle w_3, w_2 \rangle, \quad \langle w_3, w_3 \rangle, \\
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\]
Suppose it’s raining in $w_1, w_2$, sunny in $w_3$ and snowing in $w_4$.

What’s the weather like? = $\{w_1, w_2\}, \{w_3\}, \{w_4\}$.

$\bigcap\{w_1, w_2, w_3, w_4\} \ominus p \mid p \in \{\text{what’s the weather like}\} = \{\langle w_1, w_1 \rangle, \langle w_1, w_2 \rangle, \langle w_2, w_1 \rangle, \langle w_2, w_2 \rangle, \langle w_3, w_3 \rangle, \langle w_4, w_4 \rangle\}$
(50) **Questioning**

\[ c' = c + ['\text{Question}_a(\phi)'] = \langle c_{s_c}, v_c, \text{push}(Q_c, [\phi]) \rangle \]

Felicity conditions: appropriate in \( c \) at \( w \) only if

a. \( |\text{Alts}(CQU\text{D}(c'))| > 1 \),

b. if \( |Q_c| \geq 1 \), then \( CQU\text{D}(c) \subseteq CQU\text{D}(c') \), and

c. \( \text{Dox}_a(w) \cap c_{s_{c'}} \cap v_{c'} \) does not resolve \( CQU\text{D}(c') \).
(50) **Questioning**

\[ c' = c + _\exists \text{Question}_a(\phi) = \langle cs_c, v_c, \text{push}(Q_c, \llbracket \phi \rrbracket) \rangle \]

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c. \( \text{Dox}_a(w) \cap cs_{c'} \cap v_{c'} \) does not resolve \( \text{CQU}_D(c') \).

(51) **Automatic dispelling**

At any point \( c_n \) in a conversation, if \( |\text{Alts}(\text{CQU}_D(c_n))| = 1 \) and \( |Q_c| \geq 1 \), by default:

a. adjust \( c_n \) to \( c'_n = c_n + _\exists \text{Pop} + _\exists \text{Dispel} \)
Conditional questions

(52) Where $\psi$ includes a force operator,

$$c + \langle \text{if } \phi, \psi \rangle = c + \langle \text{Assume}(\phi) \rangle + \langle \psi \rangle$$
Conditional questions

(52) Where $\psi$ includes a force operator,

$$c + \neg \text{if } \phi, \psi = c + \neg \text{Assume}(\phi) + \neg \psi$$

So, if $\psi$ is an assertion:

1. Assume the antecedent.
2. Incorporate $\psi$ into the context set, within the temporary domain restriction.
(52) Where $\psi$ includes a force operator,

$$c + \text{if } \phi, \psi \neg = c + \text{Assume}(\phi) \neg + \text{if } \psi \neg$$

So, if $\psi$ is an assertion:

1. Assume the antecedent.
2. Incorporate $\psi$ into the context set, within the temporary domain restriction.

If $\psi$ is a question:

1. Assume the antecedent.
2. Raise a QUD relative to the temporary domain restriction. The question needs to be resolved before the assumption can be popped.
Suppose it’s raining in $w_1, w_2$, sunny in $w_3$, snowing in $w_4$.

(53) If it’s not snowing, what’s the weather like?
Suppose it’s raining in $w_1, w_2$, sunny in $w_3$, snowing in $w_4$.

(53) If it’s not snowing, what’s the weather like?

\[ c_0 + \langle \text{Assume}(\neg S) \rangle + \langle \text{Question(What’s the weather)} \rangle \]

\[ = \langle \{w_1, w_2, w_3, w_4\}, \{w_1, w_2, w_3\}, \langle \text{what’s the weather} \rangle, \langle \rangle \rangle \]
Suppose it’s raining in \( w_1, w_2 \), sunny in \( w_3 \), snowing in \( w_4 \).

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\[
c_0 + \langle \text{Assume}(\neg S) \rangle + \langle \text{Question}(\text{What’s the weather}) \rangle
= \langle \{w_1, w_2, w_3, w_4\}, \{w_1, w_2, w_3\}, \langle \text{what’s the weather} \rangle, \langle \rangle \rangle
\]

\[
c_0 = \langle \{w_1, w_2, w_3, w_4\}, \{w_1, w_2, w_3, w_4\}, \langle \rangle \rangle
\]

\[
CQUU\(d(c_0) = \left\{ \langle w_1, w_1 \rangle, \langle w_1, w_2 \rangle, \langle w_1, w_3 \rangle, \langle w_1, w_4 \rangle, \langle w_2, w_1 \rangle, \langle w_2, w_2 \rangle, \langle w_2, w_3 \rangle, \langle w_2, w_4 \rangle, \langle w_3, w_1 \rangle, \langle w_3, w_2 \rangle, \langle w_3, w_3 \rangle, \langle w_3, w_4 \rangle, \langle w_4, w_1 \rangle, \langle w_4, w_2 \rangle, \langle w_4, w_3 \rangle, \langle w_4, w_4 \rangle \right\}
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Suppose it’s raining in \(w_1, w_2\), sunny in \(w_3\), snowing in \(w_4\).

(53) If it’s not snowing, what’s the weather like?

\[
c_0 + \lnot \text{Assume(} \lnot S) = \lnot \text{Question(} \lnot \text{What's the weather})
\]

\[
= \langle \{w_1, w_2, w_3, w_4\}, \{w_1, w_2, w_3\}, \langle \lnot \text{what's the weather}, \rangle \rangle
\]

\[
c_1 = c_0 + \lnot \text{Assume(} \lnot S) = \langle \{w_1, w_2, w_3, w_4\}, \{w_1, w_2, w_3\}, \rangle
\]

\[
\text{CQUAD}(c_1) = \begin{cases} 
\langle w_1, w_1 \rangle, & \langle w_1, w_2 \rangle, & \langle w_1, w_3 \rangle, & \langle w_1, w_4 \rangle, \\
\langle w_2, w_1 \rangle, & \langle w_2, w_2 \rangle, & \langle w_2, w_3 \rangle, & \langle w_2, w_4 \rangle, \\
\langle w_3, w_1 \rangle, & \langle w_3, w_2 \rangle, & \langle w_3, w_3 \rangle, & \langle w_3, w_4 \rangle, \\
\langle w_4, w_1 \rangle, & \langle w_4, w_2 \rangle, & \langle w_4, w_3 \rangle, & \langle w_4, w_4 \rangle 
\end{cases}
\]
Suppose it’s raining in $w_1, w_2$, sunny in $w_3$, snowing in $w_4$.

(53) If it’s not snowing, what’s the weather like?

\[
c_0 + \lnot \text{Assume}(\lnot S) + \lnot \text{Question}(\lnot \text{What's the weather})
= \langle \{w_1, w_2, w_3, w_4\}, \{w_1, w_2, w_3\}, \langle \lbrack \text{what's the weather} \rbrack, \langle \rangle \rangle
\]

\[
c_1 = c_0 + \lnot \text{Assume}(\lnot S)
= \langle \{w_1, w_2, w_3, w_4\}, \{w_1, w_2, w_3\}, \langle \rangle \rangle
\]

\[
CQUĐ(c_1) = \left\{ \begin{array}{c}
\langle w_1, w_1 \rangle, \quad \langle w_1, w_2 \rangle, \quad \langle w_1, w_3 \rangle, \\
\langle w_2, w_1 \rangle, \quad \langle w_2, w_2 \rangle, \quad \langle w_2, w_3 \rangle, \\
\langle w_3, w_1 \rangle, \quad \langle w_3, w_2 \rangle, \quad \langle w_3, w_3 \rangle
\end{array} \right\}
\]
Suppose it’s raining in $w_1, w_2$, sunny in $w_3$, snowing in $w_4$.

(53) If it’s not snowing, what’s the weather like?

$c_0 + \llbracket \text{Assume}(\neg S) \rrbracket + \llbracket \text{Question}(\llbracket \text{What’s the weather} \rrbracket) \rrbracket$

\[ = \langle \{w_1, w_2, w_3, w_4\}, \{w_1, w_2, w_3\}, \llbracket \text{what’s the weather} \rrbracket, \langle \rangle \rangle \]

\[ c_2 = c_1 + \llbracket \text{Question}(\llbracket \text{What’s the weather} \rrbracket) \rrbracket \]

\[ = \langle \{w_1, w_2, w_3, w_4\}, \{w_1, w_2, w_3\}, \langle \{\{w_1, w_2\}, \{w_3\}, \{w_4\}\}, \langle \rangle \rangle \rangle \]

\[
CQUU(c_2) = \begin{cases}
    \langle w_1, w_1 \rangle, & \langle w_1, w_2 \rangle, & \langle w_1, w_3 \rangle, \\
    \langle w_2, w_1 \rangle, & \langle w_2, w_2 \rangle, & \langle w_2, w_3 \rangle, \\
    \langle w_3, w_1 \rangle, & \langle w_3, w_2 \rangle, & \langle w_3, w_3 \rangle
\end{cases}
\]
Suppose it’s raining in $w_1, w_2$, sunny in $w_3$, snowing in $w_4$.

(53) If it’s not snowing, what’s the weather like?

$$c_0 + \Box \text{Assume}(\neg S) + \Box \text{Question}(\Box \text{What’s the weather})$$

$$= \langle \{w_1, w_2, w_3, w_4\}, \{w_1, w_2, w_3\}, \langle \langle \{w_1, w_2\}, \{w_3\}, \{w_4\} \rangle \rangle \rangle$$

$$c_2 = c_1 + \Box \text{Question}(\Box \text{What’s the weather})$$

$$= \langle \{w_1, w_2, w_3, w_4\}, \{w_1, w_2, w_3\}, \langle \langle \{w_1, w_2\}, \{w_3\}, \{w_4\} \rangle \rangle \rangle$$

$$CQUAD(c_2) = \left\{ \begin{array}{c}
\langle w_1, w_1 \rangle, \quad \langle w_1, w_2 \rangle, \\
\langle w_2, w_1 \rangle, \quad \langle w_2, w_2 \rangle, \\
\langle w_3, w_3 \rangle 
\end{array} \right\}$$
New analysis of ‘what if’:
What-ifs are purely suppositional questions.

\[ c' = c + \neg \text{what if } \phi \neg = c + \neg \text{Assume}(\phi) \neg \]

Felicity conditions:

a. \[ |\text{Alts}(\text{CQUQ}(c'))| > 1 \]  (inquisitiveness)

b. \[ \text{Dox}_a(w) \cap cs_{c'} \cap v_{c'} \text{ does not resolve } \text{CQUQ}(c'). \]
Challenging ‘what if’ s revisited

(55)  A: Are you going to the party?
B: No, I don’t think so.
A: What if Joanna is there?
Challenging ‘what if’ s revisited

(55)  
A: Are you going to the party?  
B: No, I don’t think so.  
A: What if Joanna is there?

Sketch (Rawlins 2010a, Bledin & Rawlins 2016):

- B issues a proposal for updating the common ground, as in Farkas & Bruce (2010).
- A does not accept the proposal, but uses the ‘what if’ to resist B’s proposal.
- Supposition draws attention to the possibility that Joanna is there, which may have been ignored or forgotten before.
Generalization

Hypothetical and consequential ‘what if’s occur when the local overtly triggered QUD is closed, or there is no obviously immediate open QUD at all.

- Proposal: when the topic stack is empty, can accommodate an implicit ‘big question’.
Hypothetical/consequential ‘what if’ s: force accommodation of an implicit ‘big question’.

What is the biggest question possible?

• Hypothetical ‘what if’ s: evidence that it can be quite big.
  Worst case: \( \{ \langle w, w \rangle \mid w \in cs_c \cap v_c \} \)??
Hypothetical/consequential ‘what if’ s: force accommodation of an implicit ‘big question’.

• **Constraint 1**: often, but not necessarily, anchored at a particular time. (Partition on historical alternatives anchored at the ‘if’-clause’s time in the sense of Kaufmann & Schwager 2009).
Hypothetical/consequential ‘what if’ s: force accommodation of an implicit ‘big question’.

• **Constraint 2**: Bledin & Rawlins (2016): a lower bound on the current QUD is attention – can only ‘see’ alternatives at the granularity you are attending to.

Contrast with ‘what about if’ questions – allow implicit antecedents, but must be ones that have been plausibly raised in discourse.

(56)  #What about if I entered the atmosphere in my car?

(57)  A:   Alfonso’s going to the party.
       B:   ??Uh oh, what about if Joanna is there?
Generalizing to decision problems
Two unfinished puzzles

1. What, exactly, to do with suggestion uses?
2. What to do about the intuition that ‘what if’s are collaborative?
Toy scenario: we invite Alfonso in $w_1, w_2$ and Joanna in $w_3, w_4$. 

$CS_c = \{w_1, w_2, w_3, w_4\}$

(58) \[ A: \text{Who should we invite?} \]

\[
CQU DC + \{A\} = \{\langle w_1, w_1 \rangle, \langle w_1, w_2 \rangle, \langle w_2, w_1 \rangle, \langle w_2, w_2 \rangle, \langle w_3, w_3 \rangle, \langle w_3, w_4 \rangle, \langle w_4, w_3 \rangle, \langle w_4, w_4 \rangle\}
\]
Why suggestion uses are a problem

Toy scenario: we invite Alfonso in \( w_1, w_2 \) and Joanna in \( w_3, w_4 \).

\( CS_c = \{ w_1, w_2, w_3, w_4 \} \)

(58) A: Who should we invite?

\[
CQUD(c + \neg A) = \begin{cases} 
\langle w_1, w_1 \rangle, \langle w_1, w_2 \rangle, \\
\langle w_2, w_1 \rangle, \langle w_2, w_2 \rangle, \\
\langle w_3, w_3 \rangle, \langle w_3, w_4 \rangle, \\
\langle w_4, w_3 \rangle, \langle w_4, w_4 \rangle 
\end{cases}
\]

B: What if we invite Joanna?

Why suggestion uses are a problem

Toy scenario: we invite Alfonso in $w_1, w_2$ and Joanna in $w_3, w_4$.

$CS_c = \{w_1, w_2, w_3, w_4\}$

(58) A: Who should we invite?

$$CQU_{\text{D}}(c + \Gamma A \neg) = \begin{cases} 
\langle w_1, w_1 \rangle, \langle w_1, w_2 \rangle, \\
\langle w_2, w_1 \rangle, \langle w_2, w_2 \rangle, \\
\langle w_3, w_3 \rangle, \langle w_3, w_4 \rangle, \\
\langle w_4, w_3 \rangle, \langle w_4, w_4 \rangle 
\end{cases}$$

B: What if we invite Joanna?

$$CQU_{\text{D}}(c + \Gamma A \neg + \Gamma B \neg) = \begin{cases} 
\langle w_3, w_3 \rangle, \langle w_3, w_4 \rangle, \\
\langle w_4, w_3 \rangle, \langle w_4, w_4 \rangle 
\end{cases}$$

Failure: felicitous only if $CQU_{\text{D}}(c + \Gamma A \neg + \Gamma B \neg)$ is inquisitive.
More on suggestion uses

Simple idea 1

Drop the inquisitive requirement (keep non-resolvedness).

**Problem**: answers to suggestion ‘what if’s.

- That's a great idea, let's do it.
- She would give a good talk.
- Her talks are too mathematical for this audience.
- ok / sure.
- #yes / #no.
Simple idea 1
Drop the inquisitive requirement (keep non-resolvedness).

**Problem**: answers to suggestion ‘what if’s.

(59) What if we invite Joanna?
   a. That’s a great idea, let’s do it.
   b. She would give a good talk.
   c. Her talks are too mathematical for this audience.
   d. ok / sure.
   e. #yes / #no.
More on suggestion uses

<table>
<thead>
<tr>
<th>Simple idea 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current prediction (with a bit more about accommodation): felicitous only if there’s an implicit sub-QUD that renders the suppositional context inquisitive.</td>
</tr>
</tbody>
</table>
More on suggestion uses

Simple idea 2

Current prediction (with a bit more about accommodation): felicitous only if there’s an implicit sub-QUD that renders the suppositional context inquisitive.

Intuition:

(60) A: What if we invite Joanna?

     implicit: (How would that meet our goals for this talk series?)
Current prediction (with a bit more about accommodation): felicitous only if there’s an implicit sub-QUD that renders the suppositional context inquisitive.

**Problem:** too unconstrained, not just any QUDs are available.

(61)  
A: I wasn’t there, who gave the best talk?  
B: #What if Joanna did?  
e.g.: (What makes a talk good?)

(62)  
A: I can’t see the window, what’s the weather like?  
B: #What if it’s raining?  
e.g.: (Where should we go for lunch if it is?)
Questions can be asked not just to get information, but to help resolve a **salient decision problem** about actions faced by agents in discourse. (van Rooy 2003)

- ‘What if’ s can indicate an unresolved decision problem. (Not just an inquisitive context.)
- Decision problem is typically an implicit super-question.
- Implementation converges with Roberts (1996, 2012): need to represent both domain goals and conversational goals.
Goal structures are tuples \( G = \langle M, S, U \rangle \), where

a. \( M, S \subseteq \mathcal{P}(W) \). (wrong on handout)

b. \( M \) characterizes a set of possible moves.

c. \( S \) characterizes a set of possible states.

d. \( U \) is an ordinal utility function \( M \times S \to \mathbb{R} \).
What is a move?

I’m not going to try to pin this down, but large literature exists on planning etc. Some examples:

- opening a window.
- not opening a window.
- making an assertion in discourse.
- changing beliefs.
- ...

We take $U$ to represent the ordering of some agent(s) preferences.

- No indication of strength or intensity.
- (Cf. Condoravdi & Lauer 2012 preference structures, which don’t distinguish between moves/states in the same way.)
A purely interrogative goal is a goal structure $G_c$ determined entirely by a context $c$ as follows:

a. $M_c = \{ p \mid \exists P \subseteq \text{Alts}(CQUF(c)) : p = \{ w \mid \text{agents reach } c' \text{ in } w : \}$
   $\quad \quad cs_{c'} \subseteq \cup P \land cs_{c'} \subseteq cs_c \} \}$

b. $S_c = \text{Alts}(CQUF(c))$

c. $U_c(m,s) = \begin{cases} 1 & \text{if } m \subseteq s \\ 0 & \text{otherwise} \end{cases}$
A purely interrogative goal is a goal structure $G_C$ determined entirely by a context $c$ as follows:

a. $M_C = \{p | \exists P \subseteq \text{Alts}(CQU_D(c)) : p = \{w | \text{agents reach } c' \text{ in } w : c_{s_{c'}} \subseteq \bigcup P \land c_{s_{c'}} \subseteq c_s\}\}$

The set of possibilities for how $c_{s_{c'}}$ could evolve w.r.t. the CQU_D. (cf. Gunlogson’s ‘reduction set’)

b. $S_C = \text{Alts}(CQU_D(c))$

c. $U_C(m, s) = \begin{cases} 1 & \text{if } m \subseteq s \\ 0 & \text{otherwise} \end{cases}$

A simple Quality-based utility function that rewards only true complete answers.
What is the best move to make in pursuit of a goal?

(65) **Best move sets** (cf. van Rooy 2003)

Given a goal structure \( G = \langle M, S, U \rangle \):

\[
Q_G = \bigcup \{ s : U(m, s) \geq U(m', s) \text{ for all } m' \in M \} \mid m \in M
\]

Paraphrase: the states where utility of moves is optimal.
Fact: for a purely interrogative goal $G_c$ determined by $c$, 
$Q_{G_c} = \text{Alts}(CQUD(c))$

- Intuition: utility function rewards just the complete true answers to the CQUD.
Van Rooy’s proposal: Some questions can pose not just purely interrogative goals, but more complex decision problems that involve jointly deciding actions and states.

‘What if’

‘What if’ are appropriate only if there is an unresolved decision problem. They ask about information that is needed to resolve this decision problem.
Resisting imperatives

(66)  

A: Open the window.  
B: What if it’s still raining?

Suppose that imperatives indicate a speaker’s effective preference for their content (Condoravdi & Lauer 2012). B adopts A’s preference in cases where it is not raining, but resists otherwise:
Suppose that imperatives indicate a speaker's effective preference for their content (Condoravdi & Lauer 2012). B adopts A’s preference in cases where it is not raining, but resists otherwise:

<table>
<thead>
<tr>
<th>B’s goal structure G</th>
<th>rain, A prefers open</th>
<th>rain, A prefers ¬ open</th>
<th>no rain</th>
</tr>
</thead>
<tbody>
<tr>
<td>action: open</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>action: keep closed</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Resisting imperatives

Best move set in this context:

\[ Q_G = \begin{cases} 
\{ w \mid \text{rain, A prefers open in } w \} \cup \{ w \mid \text{no rain in } w \}, \\
\{ w \mid \text{no rain, A prefers } \neg \text{open in } w \} 
\end{cases} \]

- The ‘what if’ poses the question: supposing it is raining, what are your preferences? Set of alternatives for the best move is non-singleton.

- N.b. this scenario assumes enough authority that B adopts A’s preferences, leading to action.
Suggestion responses

(67) A: Who should we invite?
    B: What if we invite Joanna?

- Suppose that the core goal decision problem is defined by the following utilities:

<table>
<thead>
<tr>
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<th>state: good talk</th>
<th>state: bad talk</th>
</tr>
</thead>
<tbody>
<tr>
<td>action: invite Alfonso</td>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>action: invite Joanna</td>
<td>1</td>
<td>-1</td>
</tr>
</tbody>
</table>
Suggestion responses

(67)  A:  Who should we invite?
      B:  What if we invite Joanna?

• Suppose that the core goal (/decision problem) is defined by the following utilities:

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• ‘Who should we invite’ is a subquestion relative to the best move set for this goal.
• To resolve this decision problem under B’s supposition, one needs information about whether we are in worlds where Joanna gives a good talk or worlds where she gives a bad talk.
Summary:

- Suggestive ‘what if’s would be trivial under a purely interrogative goal.
- They are appropriate to the extent that agents can infer a salient non-pure decision problem (/enriched goal structure) which would lead to non-triviality under supposition.
Let the topic stack $Q_c$ now be a stack of goal structures.

Questioning by default pushes interrogative goals constructed from the content of an interrogative clause. Enrich with salient non-linguistic moves, depending on question type. [This is a promissory note.]

Reminder: $Q_{top}(Q_c)$ now stands for the best move set relative to context $c$.

Current QUDs: where $c$ is a context,

$$CQUD(c) = \begin{cases} \cap\{\text{matter}(cs_c \cap v_c) \otimes p \mid p \in Q_{top}(Q_c)\} & \text{if } |Q_c| \geq 1 \\ inq(cs_c \cap v_c) & \text{otherwise} \end{cases}$$

Paraphrase: all the ways of positively and negatively resolving the best move set for the current topic.
Conclusions
Main points

1. ‘What if’ s are purely suppositional questions.

2. New analysis of ‘what if’ s without a ‘re-asking’ component. Crucial to separate discourse topic from the QUD in a specific context.
Main points

1. ‘What if’ s are purely suppositional questions.

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3. Support for a suppositional analysis of conditionals: there is no consequent.
Main points

1. ‘What if’ s are purely suppositional questions.
2. New analysis of ‘what if’ s without a ‘re-asking’ component. Crucial to separate discourse topic from the QUD in a specific context.
3. Support for a suppositional analysis of conditionals: there is no consequent.
4. To account for the full range of cases, need to generalize regular informational QUD to encompass joint actions / information states.
Future work

• Further licensing constraints on ‘what if’ responses: (I claim) follow from interaction of other felicity conditions.
• Many more details of this notion of goal structure remain to be worked out!
• Other morphology that interacts with decision problems? (Davis 2009, ...)
• ‘What about’:
  (72)  A: Who should we invite?
        B: What about Joanna?
• Other discourse conditionals: ‘and if’, ‘even if’, ...
Thanks!

My collaborator on the current incarnation of this project, Justin Bledin.

Many, many people for discussion of this and related topics over the years (starting 2005!), including: James Isaacs, Pranav Anand, María Biezma, Cleo Condoravdi, Donka Farkas, Jeroen Groenendijk, Christine Gunlogson, Ruth Kramer, Bill Ladusaw, Mark Norris, Colin Wilson; 2010 audiences at SALT, WCCFL, Rochester; 2016 audiences at JHU, the Rutgers unstructured workshop, NASSLLI, SALT, the NY Philosophy of language group, and Justin Bledin’s F2016 philosophy of language seminar.
Extra slide: biscuit ‘what if’

(73) A: What if I’m hungry?  
B: There’s pizza in the fridge.

(74) A: What if they ask how old I am?  
B: You’re 19.

The ‘normal’ biscuit conditional antecedents license non-subordinate answers for ‘what if’ questions. (Franke’s ‘intelligibility’ biscuit antecedents don’t tend to work.)
More general would be to have a stack of context sets. Closer to Isaacs & Rawlins 2008, with a cleaner treatment of questions.

(75) Let a context $c$ be $\langle CS_c, Q_c \rangle$ where $CS_c$ is a stack of sets of worlds, never empty.

(76) $c + \Gamma \text{Assume}(\phi)^\uparrow = \langle \text{push}(CS_c, \text{top}(CS_c) \cap \llbracket \phi \rrbracket), Q_c \rangle$

(77) $c + \Gamma \text{pop}^\uparrow = \langle \text{pop}(CS_c), Q_c \rangle$, requires $|CS_c| > 1$

(78) Instead of $\oplus$ use $\boxplus$:

$$CS_c \boxplus_{\forall} \Gamma \phi^\uparrow = \begin{cases} 
\langle \rangle & \text{if } |CS_c| = 0 \\
\langle \text{top}(CS_c) \oplus_{\forall} \Gamma \phi^\uparrow, \text{pop}(CS_c) \boxplus_{\forall} (\Gamma \phi^\uparrow) \rangle & \text{otherwise}
\end{cases}$$

(Use the top of the stack as a view for updating everything.) Otherwise, use $\text{top}(CS_c)$ where previous defs use $v_c$ or $cs_c$. 


Farkas, Donka & Kim Bruce. 2010. On reacting to assertions and polar questions. *Journal of Semantics* 27. 81–118.


Fritz, Peter & Harvey Lederman. 2015. Standard state space models of unawareness. manuscript.


