Some aspects of the logical structure of conversation

Daniel Rothschild
All Souls, Oxford

Seth Yalcin
Berkeley

We transfer information using sentences.
How should we model this?

Traditional idea:
Sentences semantically express propositions.
Asserting a sentence is proposing to add the proposition it expresses to the common ground.

Dynamic idea:
Sentences semantically express operations on the common ground.

Traditional idea:
Sentences semantically express propositions.
Asserting a sentence is proposing to add the proposition it expresses to the common ground.

Dynamic idea:
Sentences semantically express operations on the common ground.

Quite different ideas about how a semantics for natural language should look.

Quite different ideas about how a semantics for natural language should look.

static vs. dynamic

$[[\phi]](w,t,g)=1$ iff....

$c\,[[\phi]]$ = the c' that results from changing c as follows: ...

Big picture choice.

static

dynamic

static

dynamic

static vs. dynamic

We want to understand what kind of facts could bear on this choice between frameworks.

First question: what formal properties are characteristic of the traditional picture?

Second question: do natural languages generally have these properties or not?

Third question: to what extent would the failure of the traditional picture require a dynamic compositional semantics?

plan

1. We formalize one natural idea about what makes for the staticness (dynamicness) of a system of linguistic communication.
2. We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.
3. We use that result to focus the question what it would take to show that non-static resources are required to handle any given fragment of natural language.

1 We formalize one natural idea about what makes for the staticness (dynamicness) of a system of linguistic communication.

How do the static and dynamic pictures differ?

They differ chiefly in the way that sentences are associated with their context-change potentials.

1 We formalize one natural idea about what makes for the staticness (dynamicness) of a system of linguistic communication.

How do the static and dynamic pictures differ?

They differ chiefly in the way that sentences are associated with their CCPs.

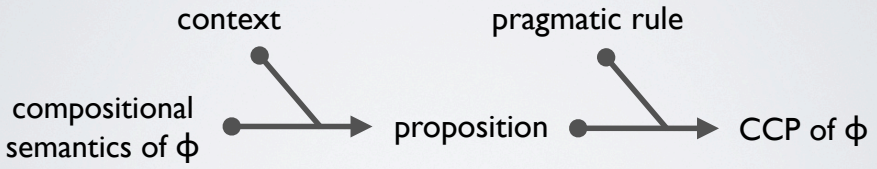
1 We formalize one natural idea about what makes for the staticness (dynamicness) of a system of linguistic communication.

How do the static and dynamic pictures differ?

They differ chiefly in the way that sentences are associated with their CCPs.

As we will understand it, the static picture implies a kind of factorability of CCP, in a way the dynamic picture does not.

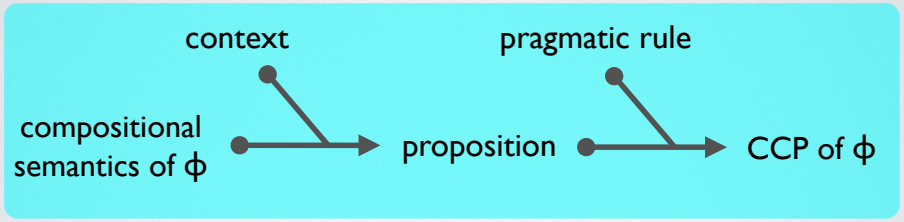
1 We formalize one natural idea about what makes for the staticness (dynamicness) of a system of linguistic communication.



the static picture

1 We formalize one natural idea about what makes for the staticness (dynamicness) of a system of linguistic communication.

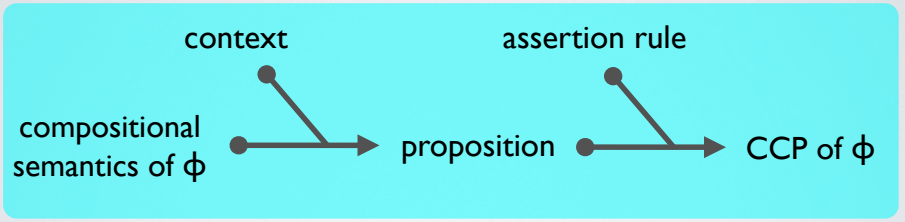
the static picture



Assertion Rule (Stalnaker 1978):
Add the proposition determined to the common ground.

1 We formalize one natural idea about what makes for the staticness (dynamicness) of a system of linguistic communication.

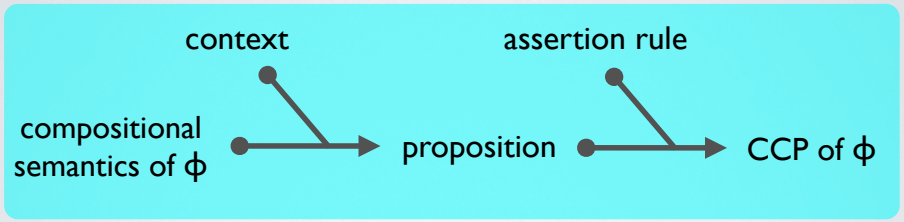
the static picture



Assertion Rule (Stalnaker 1978):
Add the proposition determined to the common ground.

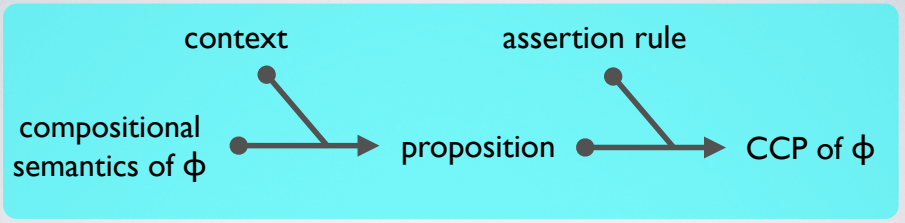
1 We formalize one natural idea about what makes for the staticness (dynamicness) of a system of linguistic communication.

the static picture



Factorability:
The CCP of ϕ can be resolved into the application of the assertion rule to a compositionally determined proposition.

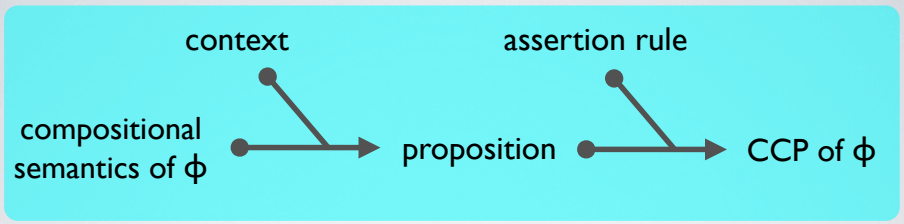
the static picture



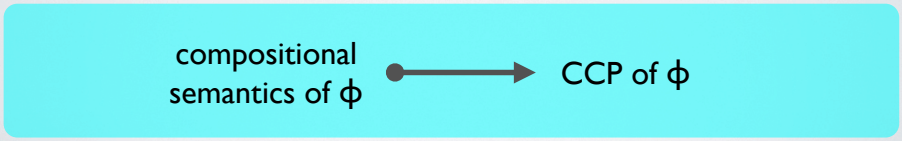
Factorability:
The CCP of ϕ can be resolved into the application of the assertion rule to a compositionally determined proposition.

The dynamic picture does not make this assumption.

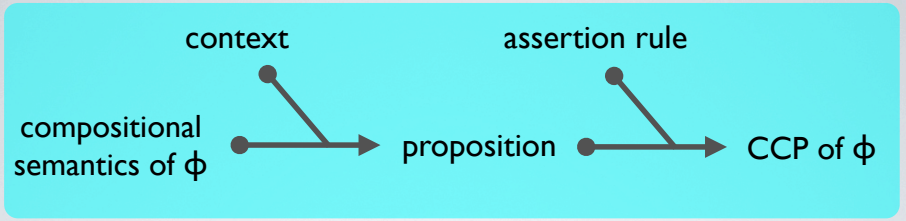
the static picture



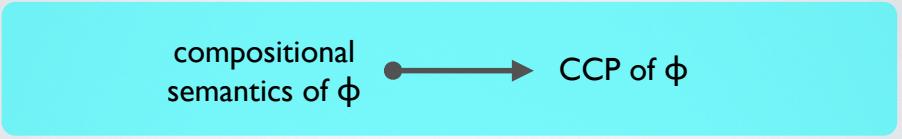
the dynamic picture



the static picture

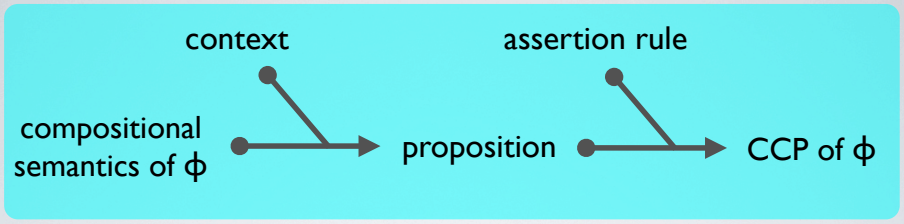


the dynamic picture

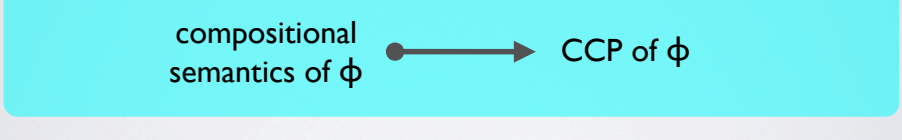


If the CCPs supplied by a dynamic semantics can be equally achieved by something fitting the static picture, there's a sense in which it's "not really dynamic".

the static picture

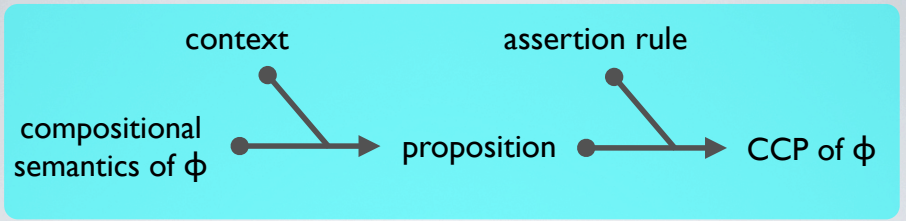


the dynamic picture

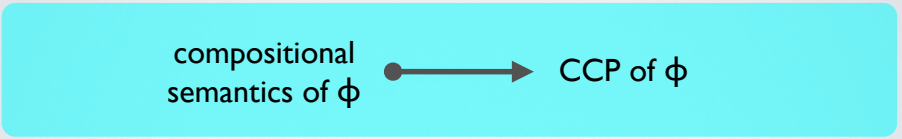


From the mere fact that a compositional semantics takes sentences directly into CCPs, it does not follow that the system is dynamic in the sense we are interested in.

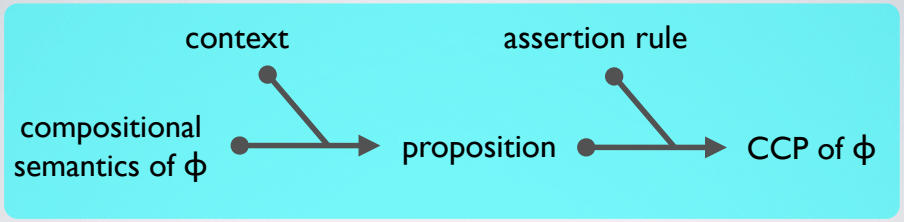
the static picture



the dynamic picture

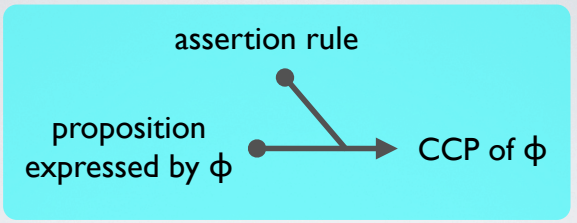


No good just looking at the shape of the semantics to understand the difference. Need a higher level of abstraction.



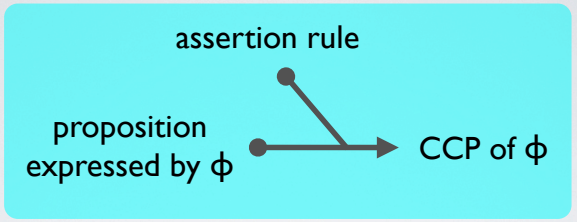
We want a description of language which includes just the information required to settle whether it is factorable.

For this, we only need the CCPs of the sentences of the language. We can abstract from the compositional details.



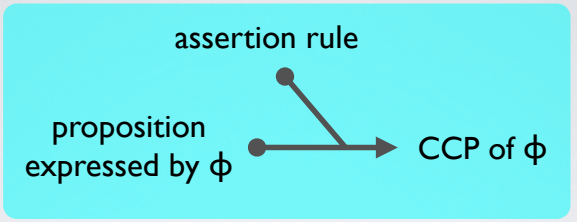
We want a description of language which includes just the information required to settle whether it is factorable.

For this, we only need the CCPs of the sentences of the language. We can abstract from the compositional details.



For this, we only need the CCPs of the sentences of the language. We can abstract from the compositional details.

Intuitive question is then: when is a given collection of CCPs for sentences representable as fitting the static picture?



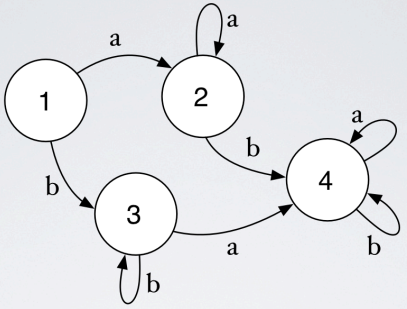
Intuitive question is then: when is a given collection of CCPs for sentences representable as fitting the static picture?

To make the question precise, we can use the idea of the **conversation system** associated with a language.

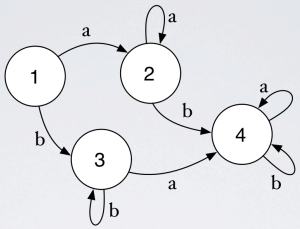
To make the question precise, we can use the idea of the **conversation system** associated with a language.

A **conversation system** is a triple $(L, C, [\cdot])$ of a set L of sentences, a domain of informational contexts C, and a mapping $[\cdot]$ from sentences of L to operations (CCPs) on C.

Just the CCPs.

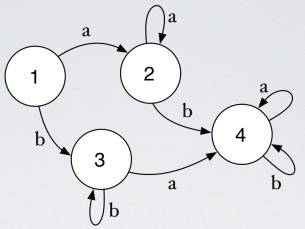


A **conversation system** is a triple $(L, C, [\cdot])$ of a set L of sentences, a domain of informational contexts C, and a mapping $[\cdot]$ from sentences of L to operations (CCPs) on C.

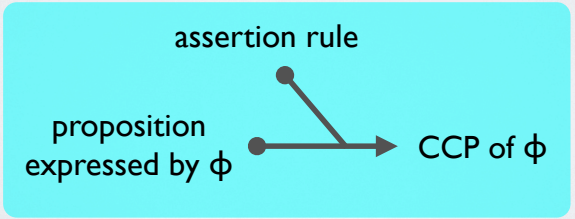


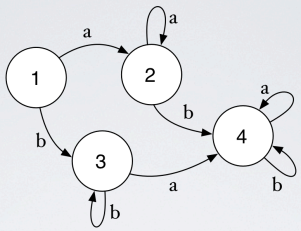
A **conversation system** is a triple $(L, C, [\cdot])$ of a set L of sentences, a domain of informational contexts C, and a mapping $[\cdot]$ from sentences of L to operations (CCPs) on C.

Straightforward to define the subclass of **static** conversation systems.

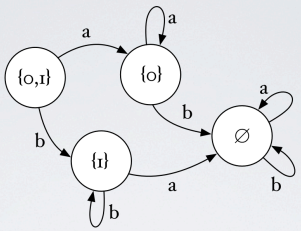


Straightforward to define the subclass of conversation systems representable along these lines:

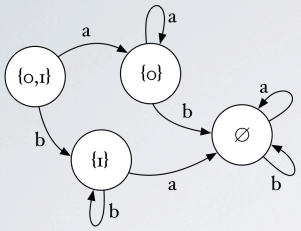




First pass:
A conversation system is static iff there is a mapping of sentences to propositions such that the update effect of any ϕ is always a matter of adding the corresponding proposition to the context.

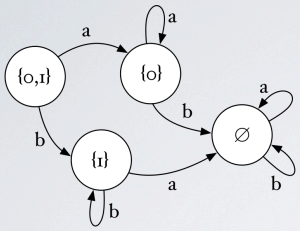


First pass:
A conversation system is static iff there is a mapping of sentences to propositions such that the update effect of any ϕ is always a matter of adding the corresponding proposition to the context.



a ⟶ {0}
b ⟶ {1}

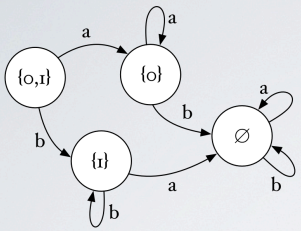
First pass:
A conversation system is static iff there is a mapping of sentences to propositions such that the update effect of any ϕ is always a matter of adding the corresponding proposition to the context.



a ⟶ {0}
b ⟶ {1}

Update by intersection

First pass:
A conversation system is static iff there is a mapping of sentences to propositions such that the update effect of any ϕ is always a matter of adding the corresponding proposition to the context.



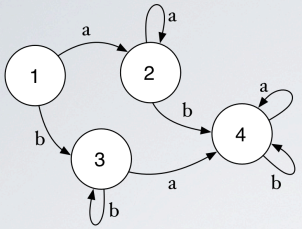
$a \longrightarrow \{0\}$

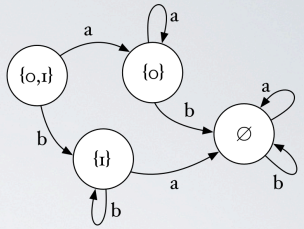
$b \longrightarrow \{1\}$

Update by intersection

Second pass:

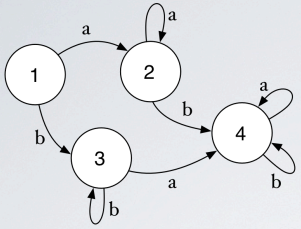
A conversation system is static iff there is a mapping of sentences to propositions such that the update effect of any ϕ is always a matter of intersecting the corresponding proposition with the context.

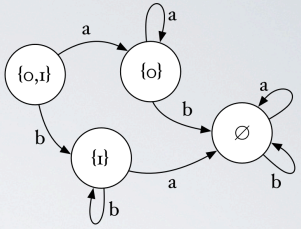




A conversation system (L, C, $[\cdot]$) is **static** if and only if there exists a set of sets P, a proposition map (L, P, $[[\cdot]]$), and a one-to-one function f from C to P such that for all $c \in C$ and $s \in L$, $f(c) \cap [[s]] = f(c[s])$.

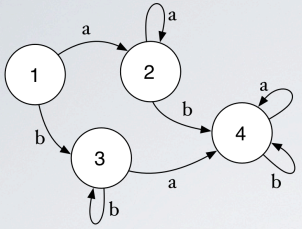
Highly general notion of static. Covers many ways of cashing out "adding a proposition to the informational context".

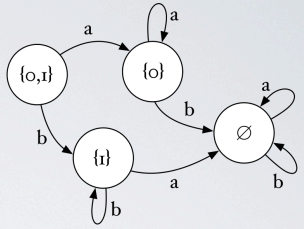




A conversation system (L, C, $[\cdot]$) is **static** if and only if there exists a set of sets P, a proposition map (L, P, $[[\cdot]]$), and a one-to-one function f from C to P such that for all $c \in C$ and $s \in L$, $f(c) \cap [[s]] = f(c[s])$.

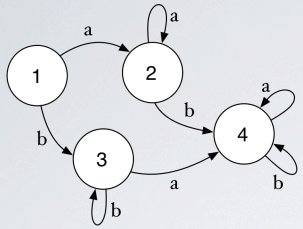
Now the question is, what makes for staticness in this sense?

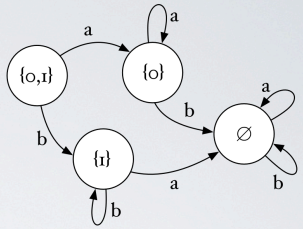




A conversation system (L, C, $[\cdot]$) is **static** if and only if there exists a set of sets P, a proposition map (L, P, $[[\cdot]]$), and a one-to-one function f from C to P such that for all $c \in C$ and $s \in L$, $f(c) \cap [[s]] = f(c[s])$.

Can we get an independent grip on this set of conversation systems?





A conversation system $(L, C, [\cdot])$ is **static** if and only if there exists a set of sets P, a proposition map $(L, P, [[\cdot]])$, and a one-to-one function f from C to P such that for all $c \in C$ and $s \in L$, $f(c) \cap [[s]] = f(c[s])$.

Can we isolate this set of conversation systems in terms of some intuitive properties?

Can we isolate this set of conversation systems in terms of some intuitive properties?

Our main result gives an affirmative answer this question.

plan

1 We formalize one natural idea about what makes for the staticness (dynamicness) of a system of linguistic communication.

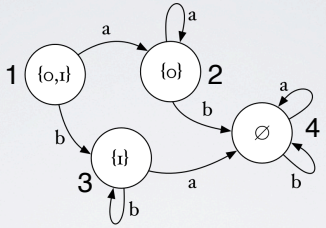
2 We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.

2 We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.

prior results

2

We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.

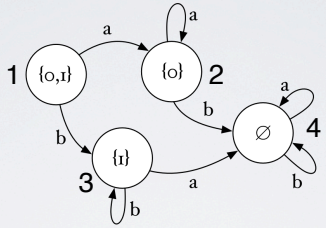


Eliminativity. $c[s] \vee c = c$
Finite distributivity. $(c \vee c')[s] = c[s] \vee c'[s]$

van Benthem 1986:
If a conversation system is eliminative and finitely distributive, it is static.

2

We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.

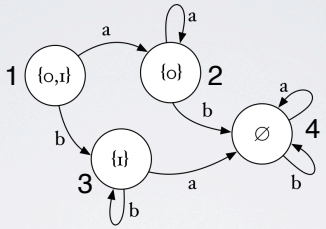


van Benthem 1986:
If a conversation system is eliminative and finitely distributive, it is static.

Perhaps the most cited relevant result.

2

We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.

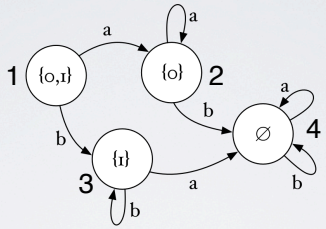


van Benthem 1986:
If a conversation system is eliminative and finitely distributive, it is static.

Only a sufficient condition, however.

2

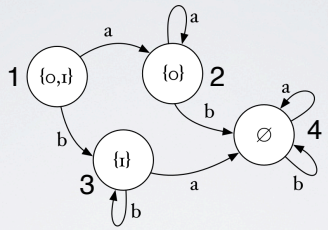
We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.



van Benthem 1986:
If a conversation system is eliminative and finitely distributive, it is static.

Only applies if the space of contexts can be equipped with Boolean structure.

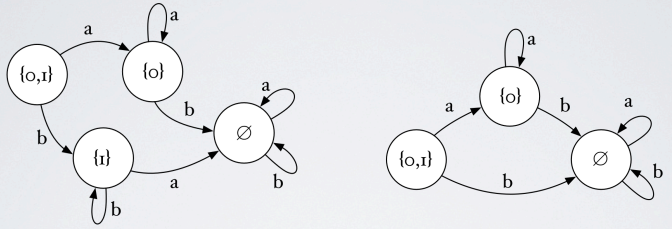
2 We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.



van Benthem 1986:
If a conversation system is eliminative and finitely distributive, it is static.

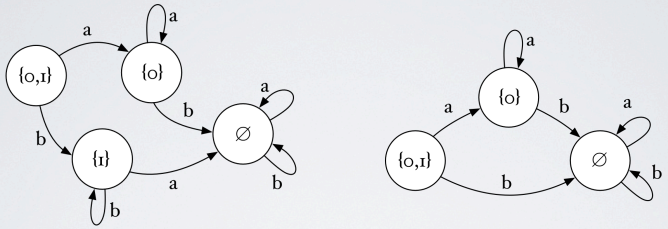
Veltman provides a more general result.

2 We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.



Veltman 1996:
If a conversation system is idempotent, persistent, monotonic and obeys strengthening, it is static.

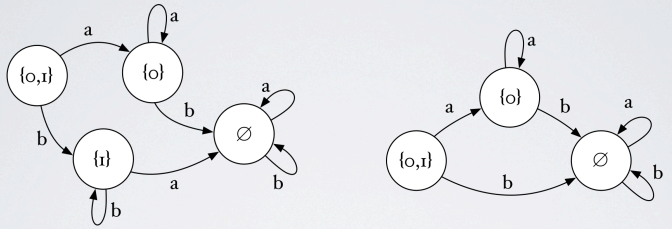
2 We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.



Veltman 1996:
If a conversation system is idempotent, persistent, monotonic and obeys strengthening, it is static.

Only applies if the space of contexts can be equipped with information lattice structure.

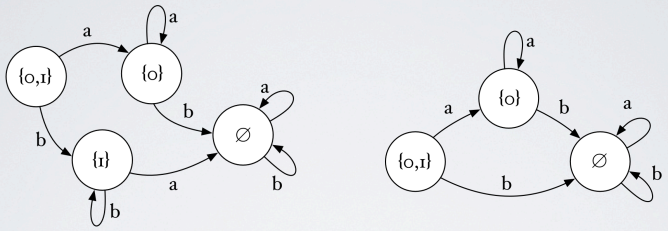
2 We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.



Veltman 1996:
If a conversation system is idempotent, persistent, monotonic and obeys strengthening, it is static.

Only applies if the space of contexts forms a bounded semilattice of a certain sort.

2 We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.



Veltman 1996:
If a conversation system is idempotent, persistent, monotonic and obeys strengthening, it is static.

More general, but complicated, and still only a sufficient condition for staticness.

2 We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.

More general, but complicated, and still only a sufficient condition for staticness.

We can say something much more general, and also more intuitive.

2 We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.

We can say something much more general, and also more intuitive.

Static representation theorem.
A conversation system is static iff it is idempotent and commutative.

Idempotence. $c[s][s] = c[s]$
Commutativity. $c[s][s'] = c[s'][s]$

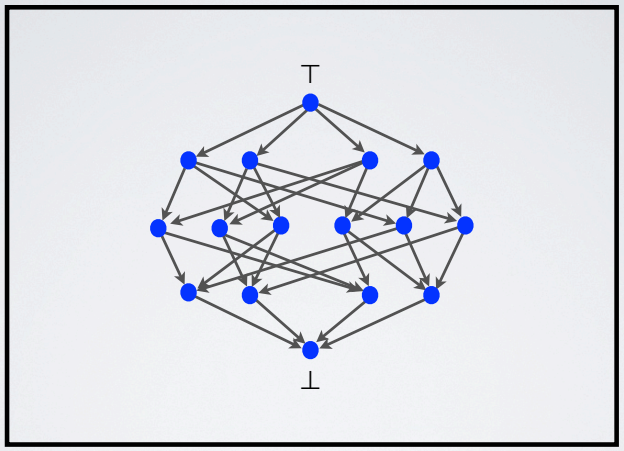
2 We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.

Static representation theorem.
A conversation system is static iff it is idempotent and commutative.

Idempotence. $c[s][s] = c[s]$
Commutativity. $c[s][s'] = c[s'][s]$

Requires no assumptions about the space of contexts.

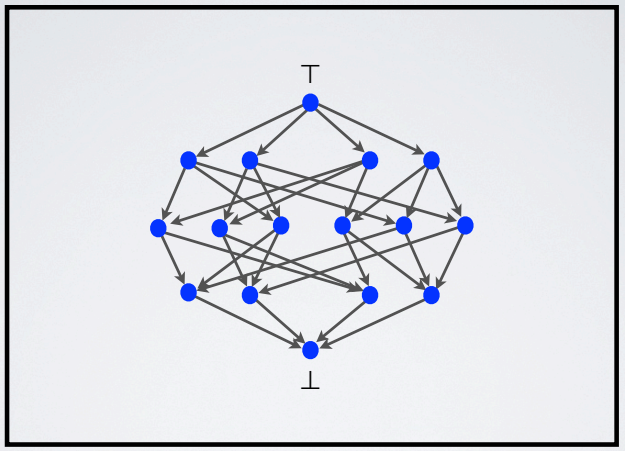
van Benthem: the space of contexts is assumed to have Boolean structure.



informationally stronger

the space of contexts

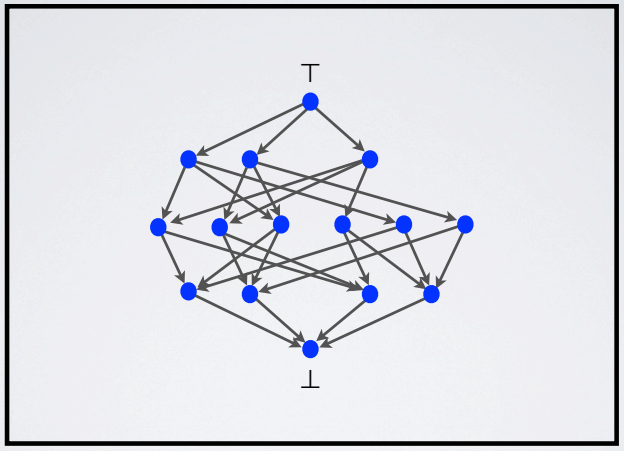
Veltman: the space of contexts is assumed to have bounded meet semilattice structure.



informationally stronger

the space of contexts

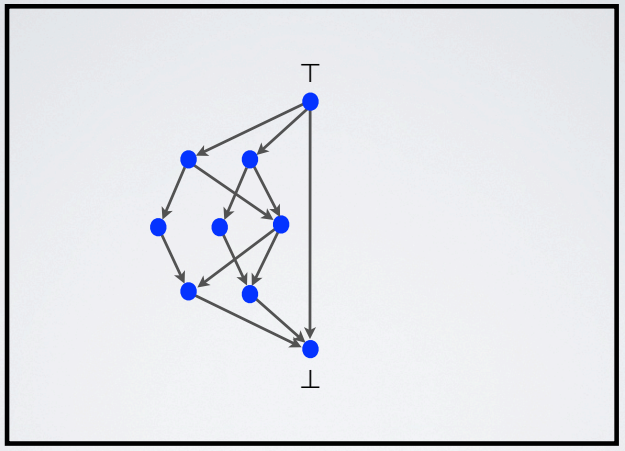
Veltman: the space of contexts is assumed to have bounded meet semilattice structure.



informationally stronger

the space of contexts

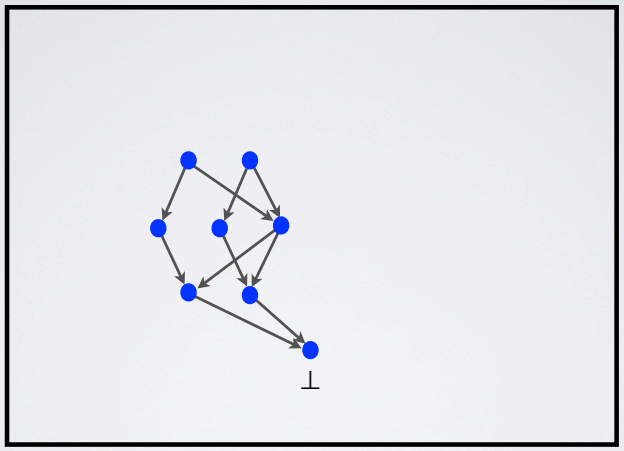
Veltman: the space of contexts is assumed to have bounded meet semilattice structure.



informationally stronger

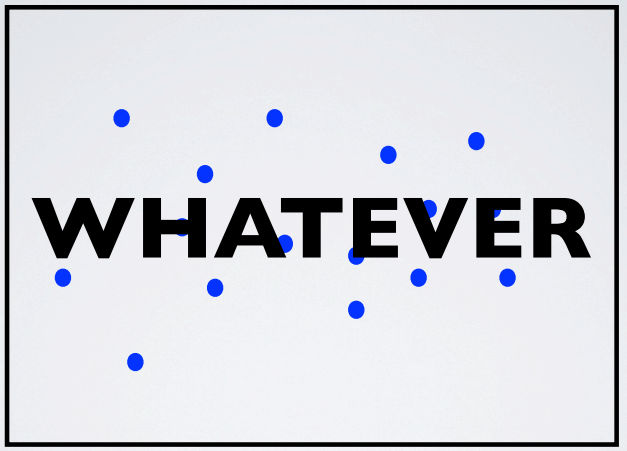
the space of contexts

Our result assumes nothing about the structure of the space of contexts.



the space of contexts

Our result assumes nothing about the structure of the space of contexts.



the space of contexts

Our result assumes nothing about the structure of the space of contexts.

"But surely the space of contexts does have such-and-such structure."

The point is that staticness can be characterized in abstraction from the structure of contexts.

Moreover, idempotence and commutativity and more intuitive, closer-to-the-surface properties.

Moreover, idempotence and commutativity and more intuitive, closer-to-the-surface properties.

Can easily say now in virtue of what various well-known dynamic semantic systems induce non-static conversation systems: they violate commutativity.

plan

2 We give a representation theorem that supplies an intuitive independent characterization of the class of static systems.

3 We use that result to focus the question what it would take to show that non-static resources are required to handle any given fragment of natural language.

plan

3 We use that result to focus the question what it would take to show that non-static resources are required to handle any given fragment of natural language.

3 We use that result to focus the question what it would take to show that non-static resources are required to handle any given fragment of natural language.

Is such-and-such fragment static?

3 We use that result to focus the question what it would take to show that non-static resources are required to handle any given fragment of natural language.

Is such-and-such fragment static?

Is its conversation system commutative & idempotent?

Idempotence: counterexamples?

c[*s*][*s*] = c[*s*]

Commutativity is the main question.

Commutativity is the main question.

1. a. Harry is married. Harry's spouse is a great cook.
   b. ?Harry's spouse is a great cook. Harry is married.

2. a. A man walked in. He was tall.
   b. ?He was tall. A man walked in.

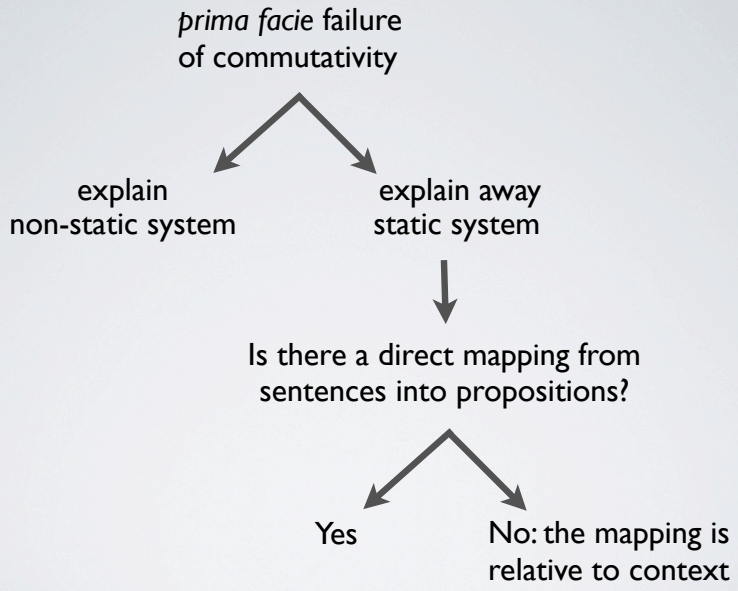
Of course, natural language abounds in *prima facie* failures of commutativity.

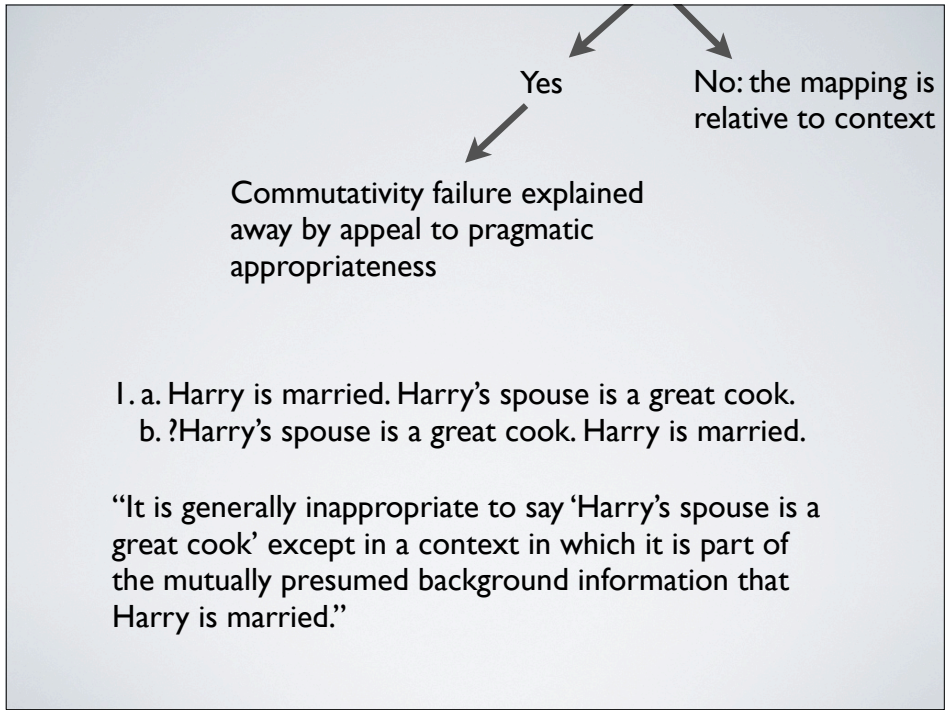
Commutativity is the main question.

Of course, natural language abounds in *prima facie* failures of commutativity.

The issue is whether the apparent failures are bonafide, or whether they should instead be explained away in a manner compatible with a purely static conversation system.

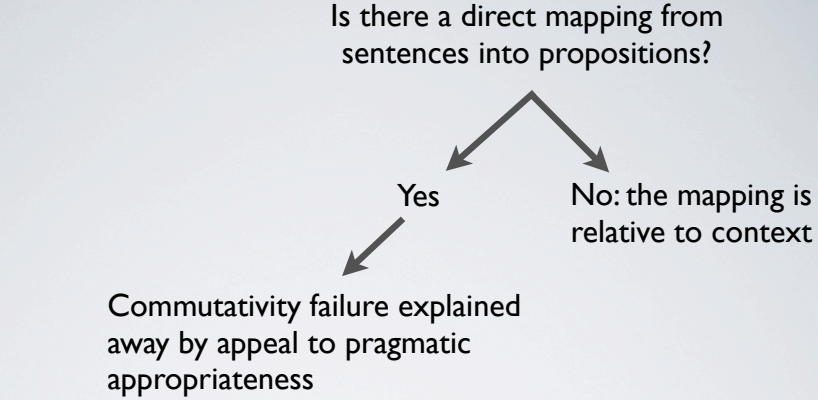
We don't aim to settle the issue, but we want to clarify the options.





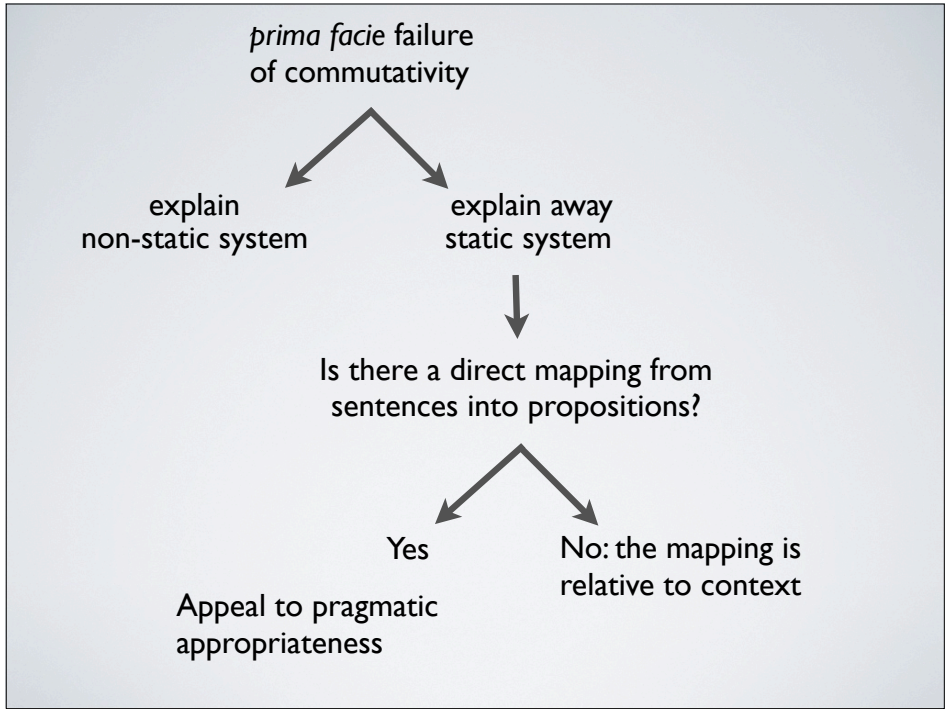
1. a. Harry is married. Harry's spouse is a great cook.
   b. ?Harry's spouse is a great cook. Harry is married.

"It is generally inappropriate to say 'Harry's spouse is a great cook' except in a context in which it is part of the mutually presumed background information that Harry is married."



Facts of pragmatic appropriateness may be sensitive to the informational context.

Obvious question: what grounds the appropriateness facts, if not the non-staticness of the conversation system?



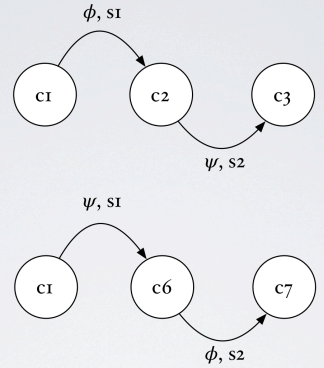
Is there a direct mapping from sentences into propositions?

Yes

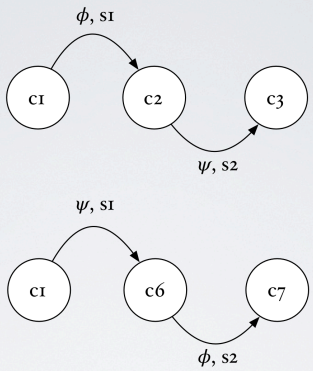
No: the mapping is relative to context

'context' in Kaplan's sense

Fundamentally, this move says: enrich the language of the conversation system. The "language" is really a set of sentence, context (discourse setting) pairs.



Fundamentally, this move says: enrich the language of the conversation system. The "language" is really a set of sentence, context (discourse setting) pairs.



Merely reversing the order in which sentences are tokened doesn't strictly make for commutation, though it creates the appearance of commutation.

Is there a direct mapping from sentences into propositions?

Yes

No: the mapping is relative to context

'context' in Kaplan's sense

Merely reversing the order in which sentences are tokened doesn't strictly make for commutation, though it creates the appearance of commutation.

Is there a direct mapping from sentences into propositions?

Yes

No: the mapping is relative to context

'context' in Kaplan's sense

- broader notion of language required

Is there a direct mapping from sentences into propositions?

Yes

No: the mapping is relative to context

'context' in Kaplan's sense

- broader notion of language required

'context' in Stalnaker's sense

Is there a direct mapping from sentences into propositions?

Yes

No: the mapping is relative to context

'context' in Kaplan's sense

- broader notion of language required

'context' in Stalnaker's sense ("info-sensitivity")

Is there a direct mapping from sentences into propositions?

Yes

No: the mapping is relative to context

'context' in Stalnaker's sense ("info-sensitivity")

This move says: allow that the proposition expressed is sometimes a function of the prior informational context.

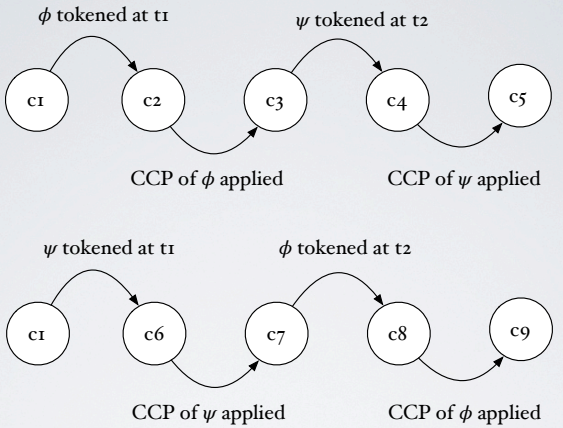
Is there a direct mapping from sentences into propositions?

Yes

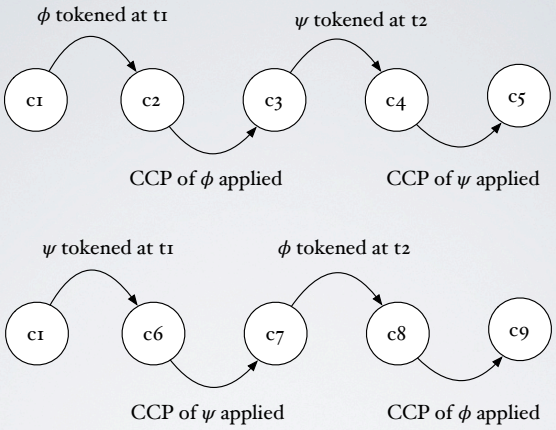
No: the mapping is relative to context

'context' in Stalnaker's sense ("info-sensitivity")

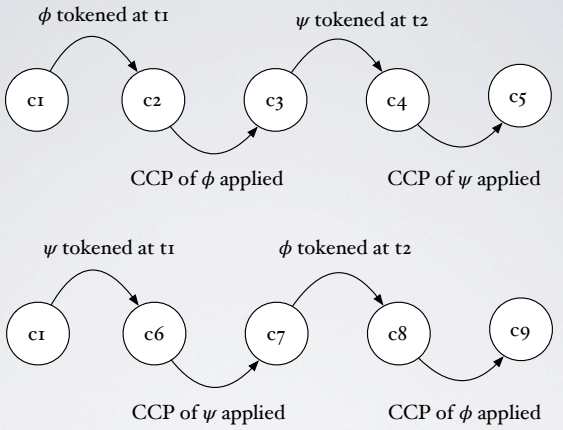
Proposition map is defined on sentence-informational context pairs.



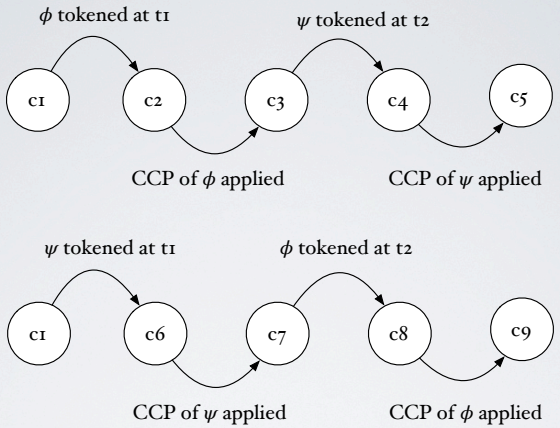
Proposition map is defined on sentence-informational context pairs.



Inter alia, allows one to capture potential sensitivity of the proposition expressed to the secondary effect of assertion on the informational context.



"What the context must determine, for the interpretation of a pronoun, is a function from worlds in the context set to individuals." Stalnaker (1998)



Information-sensitivity does not require extending the language of the conversation system.

Is there a direct mapping from sentences into propositions?

Yes

No: the mapping is relative to context

'context' in Kaplan's sense

- broader notion of language required

'context' in Stalnaker's sense ("info-sensitivity")

Information-sensitivity does not require extending the language of the conversation system.

Is there a direct mapping from sentences into propositions?

Yes

No: the mapping is relative to context

'context' in Kaplan's sense

- broader notion of language required

'context' in Stalnaker's sense ("info-sensitivity")

But information-sensitivity is not a way of vindicating staticness.

Is there a direct mapping from sentences into propositions?

Yes

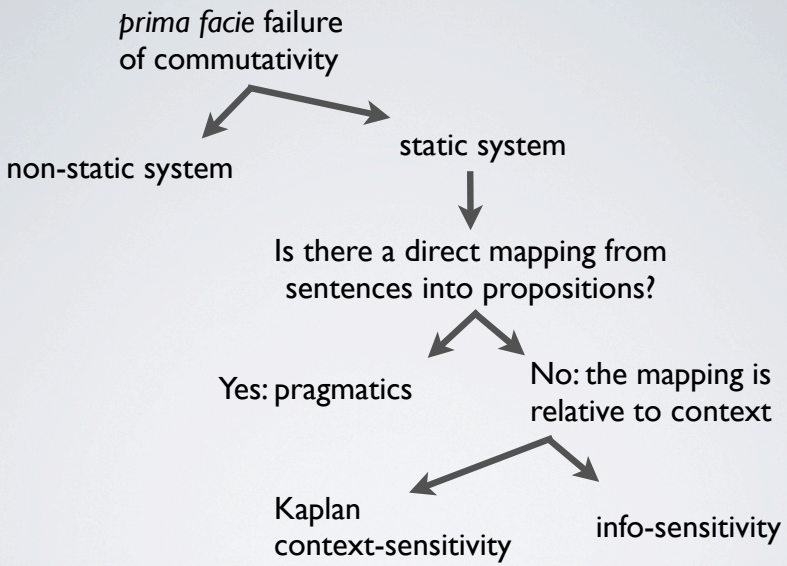
No: the mapping is relative to context

'context' in Kaplan's sense

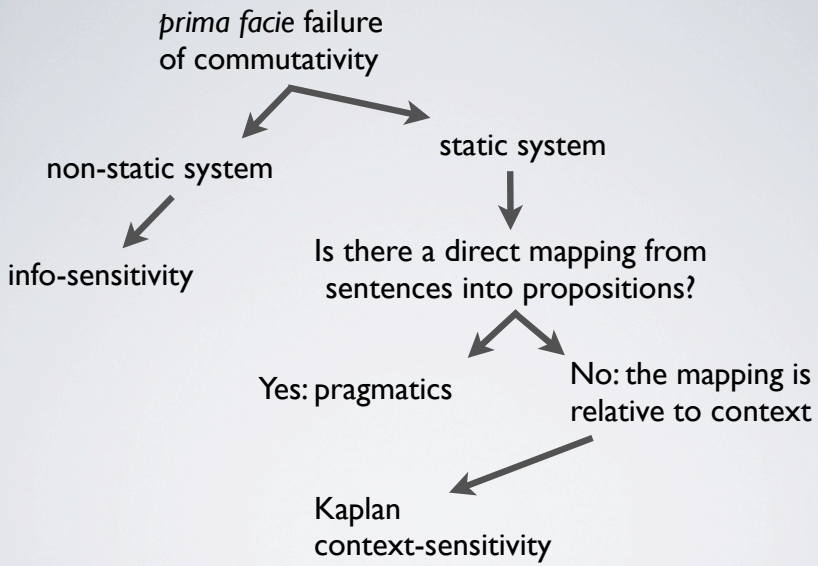
- broader notion of language required

'context' in Stalnaker's sense ("info-sensitivity")

Interestingly information-sensitive systems are not static.



Interestingly information-sensitive systems are not static.



Interestingly information-sensitive systems are not static.

Interestingly information-sensitive systems are not static.

Information-sensitivity generalizes the notion of staticness.

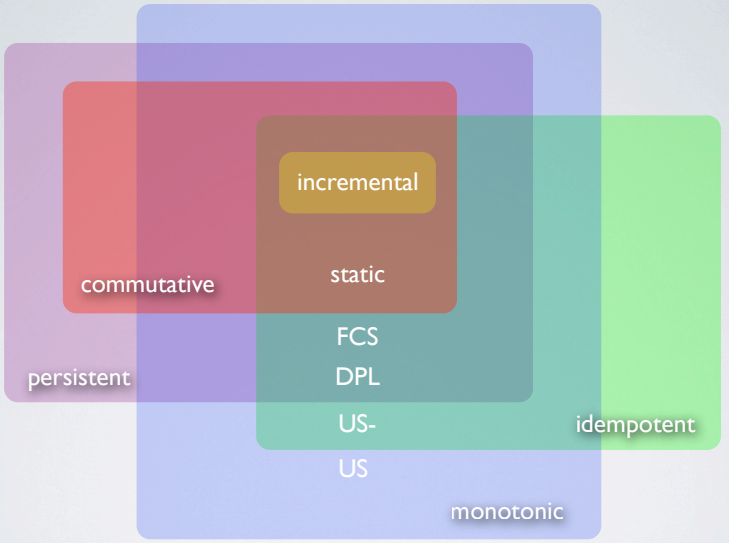
Just as we asked for an intuitive characterization of the class of static systems, we can ask for an intuitive characterization of the class of information-sensitive systems.

Answer:
A conversation system is information-sensitive just in case it is monotonic.

Just as we asked for an intuitive characterization of the class of static systems, we can ask for an intuitive characterization of the class of information-sensitive systems.

Answer:
A conversation system is information-sensitive just in case it is monotonic.

"No going back."



Suppose that the conversation system appropriate to some natural language like English were non-static. What if anything would follow concerning the character of natural language semantics?

Not much. Certainly doesn't follow that the semantics needs to take a dynamic form.

Could implement a robustly info-sensitive system within an intensional semantics.

Could implement a robustly info-sensitive system within an intensional semantics.

How ‘dynamic’ is conversational update?

What should a compositional semantics for natural language look like?

Nontrivial gap between these questions!

Thanks