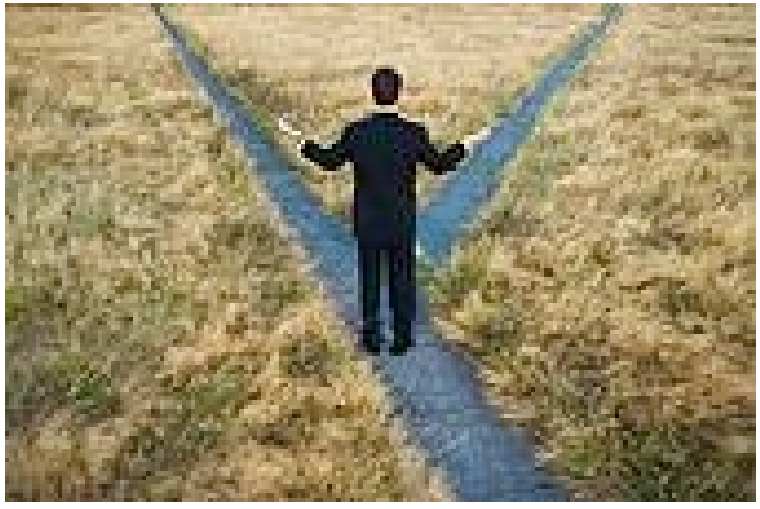
The Inquisitive Turn

A new perspective on semantics, logic, and pragmatics

Floris Roelofsen

based on joint work with
Jeroen Groenendijk and Ivano Ciardelli



San Diego, March 2, 2011

Mission statement

Inquisitive semantics

- Meaning is traditionally identified with informative content
- Our main aim is to develop a notion of meaning that captures both informative and inquisitive content

Inquisitive logic

- Logic is traditionally concerned with entailment, which rules the validity of argumentation
- We aim to develop logical notions of relatedness, which rule the coherence of conversation

Inquisitive pragmatics

- Gricean pragmatics specifies rules for providing information
- We aim to develop a pragmatics of exchanging information, taking both informative and inquisitive content into account

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Overview

Semantics

- Propositions as proposals
- Inquisitive algebra
- Projection operators

Logic

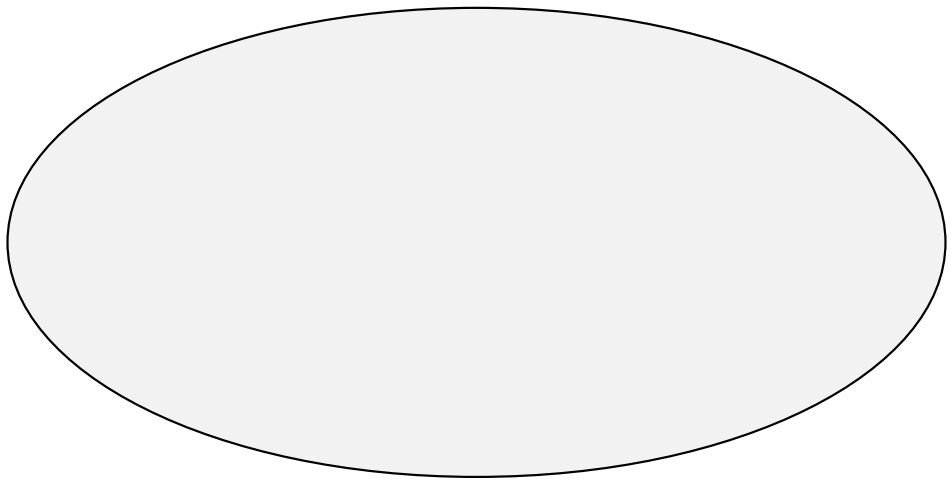
- Informative and inquisitive entailment
- Relatedness, compliance

Pragmatics

- Sincerity
- Transparency
- Relation

The Traditional Picture

- Meaning = informative content
- Providing information = eliminating possible worlds



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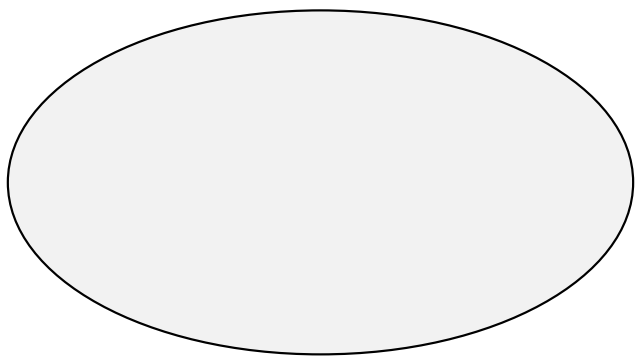

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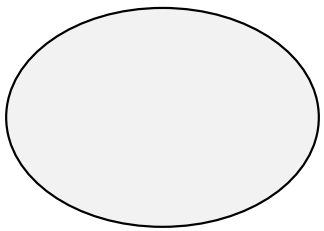

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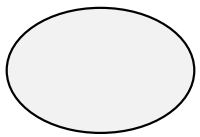

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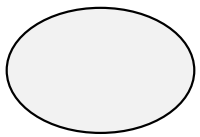
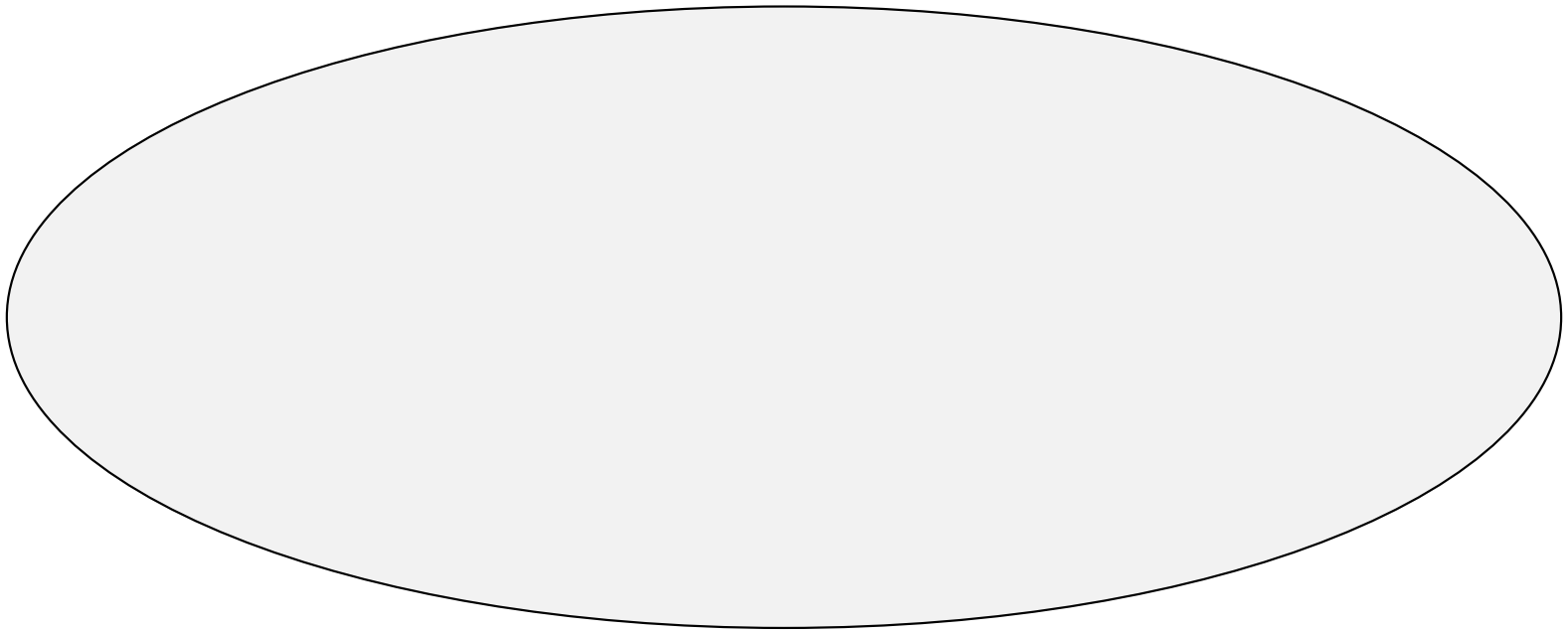


- Captures only one type of language use: providing information
- Does not reflect the cooperative nature of communication

The Inquisitive Picture

- Propositions as proposals
- A proposal consists of one or more possibilities
- An inquisitive proposal offers several alternative possibilities



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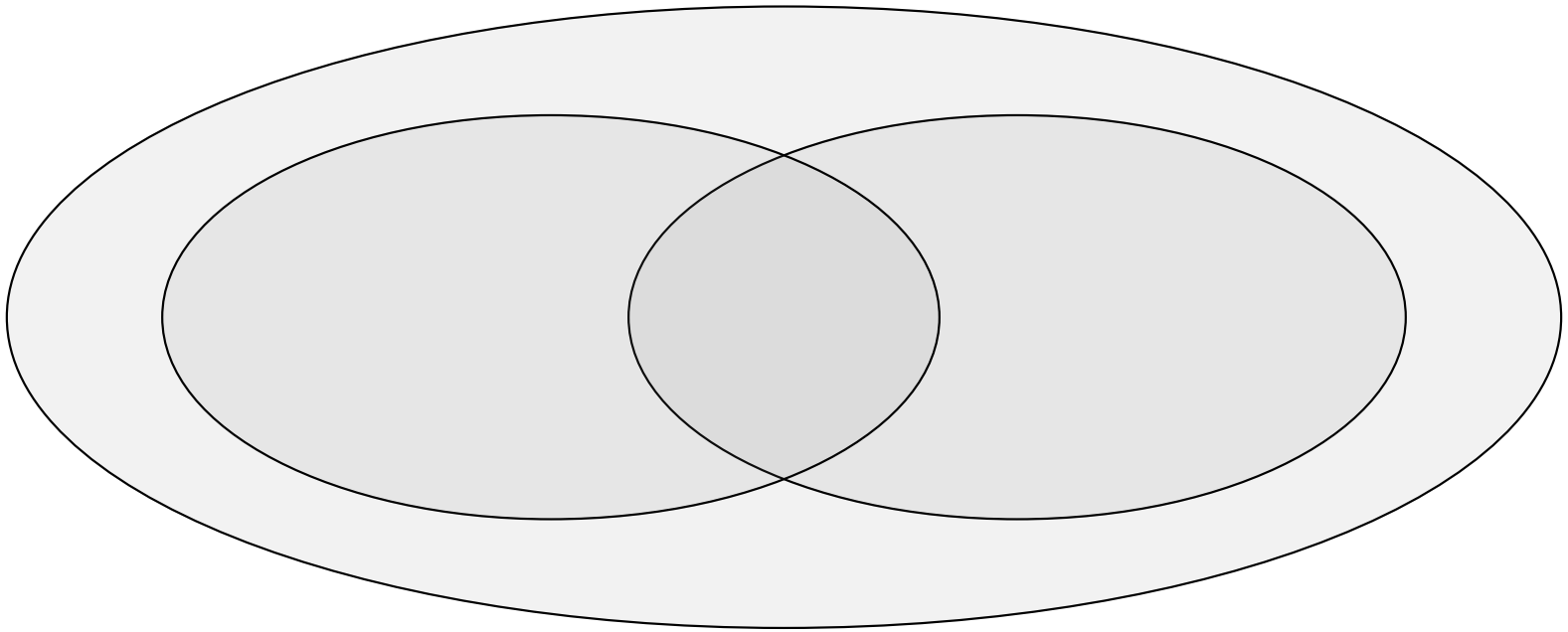

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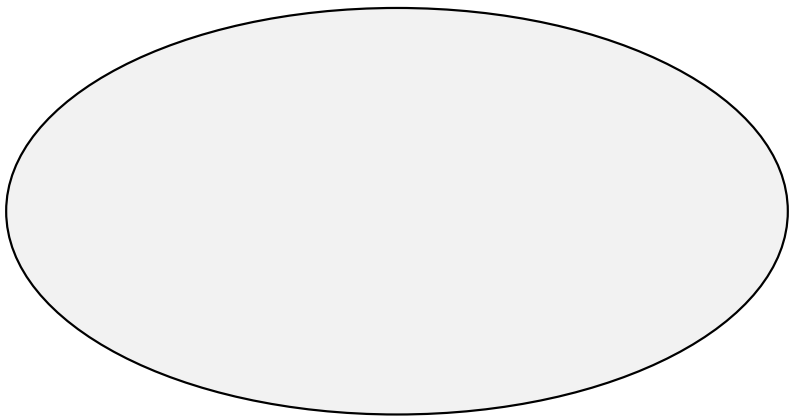

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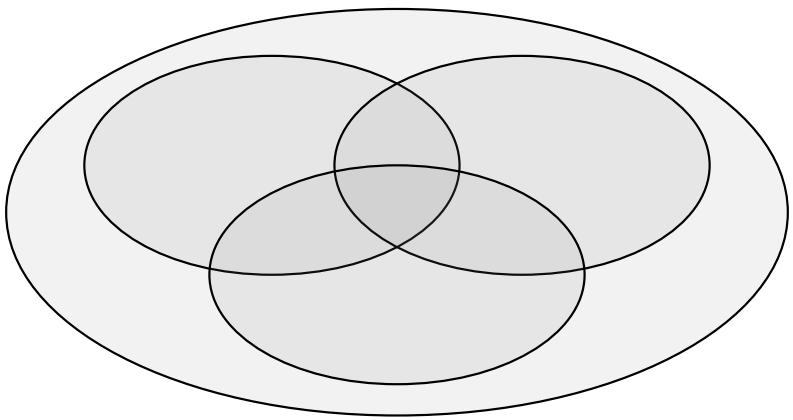

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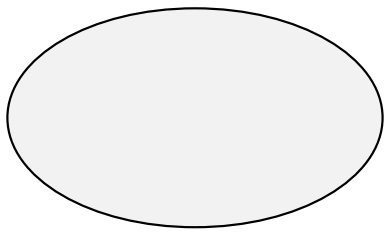
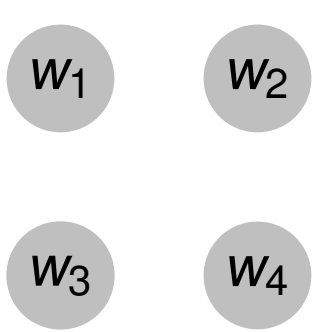


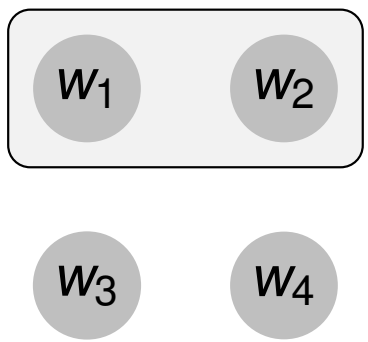
Worlds, possibilities, and propositions

- Start with a universe of possible worlds
- Possibility: set of possible worlds
- Proposition: set of possibilities

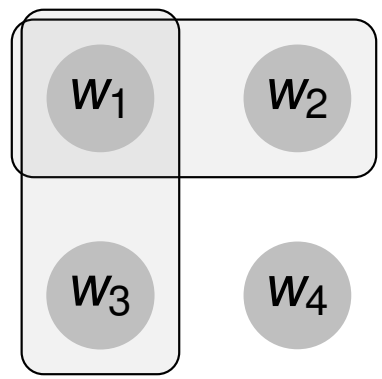
Illustration



worlds



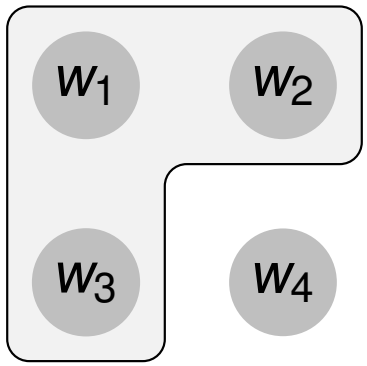
possibility



proposition

How to think of propositions?

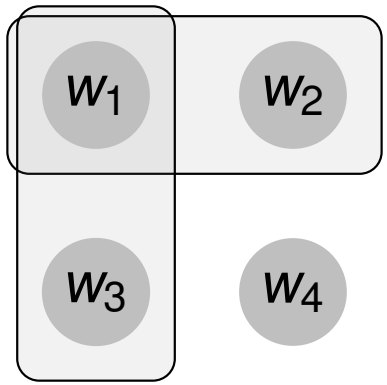
- Traditionally, a proposition is simply a set of possible worlds



- We think of such a proposition A as providing the information that the actual world corresponds to one of the worlds in A

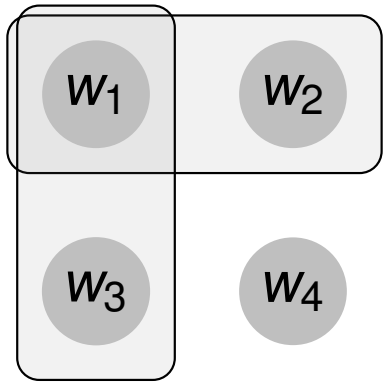
How to think of propositions?

- Now, a proposition is a set of possibilities



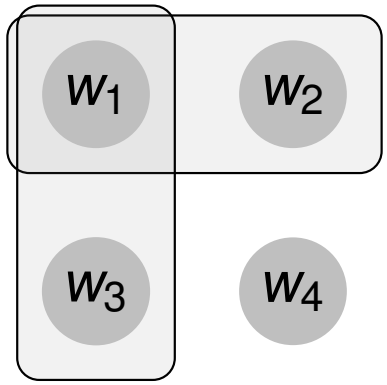
- How should we think of such propositions?
- What is the informative content that they represent?
- Could we think of them as representing something else besides informative content? If so, what exactly?

Informative and inquisitive content



- We think of a proposition A as representing a proposal to update the common ground in one or more ways
- Each possibility in A embodies one of the proposed updates
- A provides the information that the actual world is contained in at least one of the possibilities in A
- Moreover, A requests a response that provides enough information to establish at least one of the proposed updates

Informative and inquisitive content



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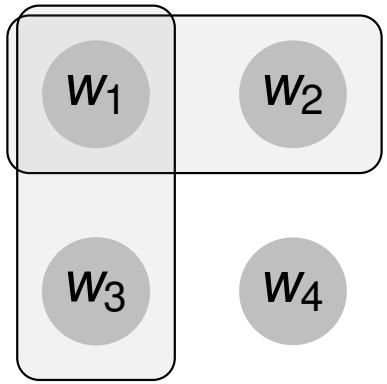
$\Rightarrow$ a single semantic object embodies both informative and inquisitive content

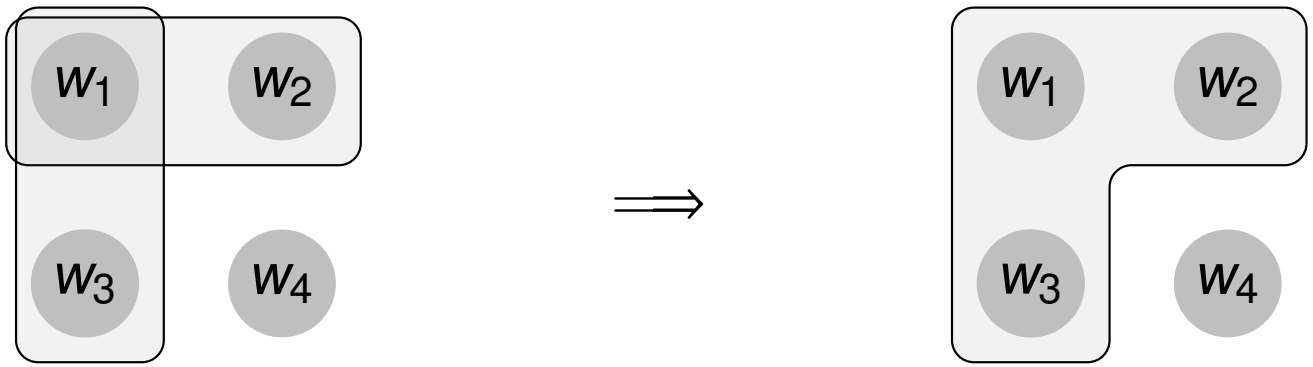
Informative content



- A proposition A provides the information that the actual world is contained in at least one of the possibilities in A
- So, the informative content of A, info(A), is determined by the union of all the possibilities in A:

$$\text{info}(A) = \bigcup A$$

Informative content



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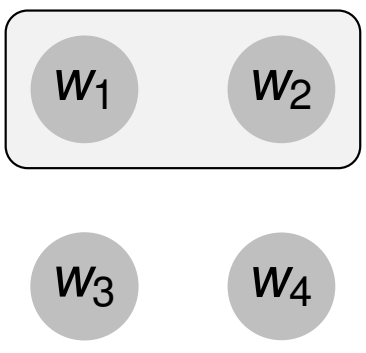
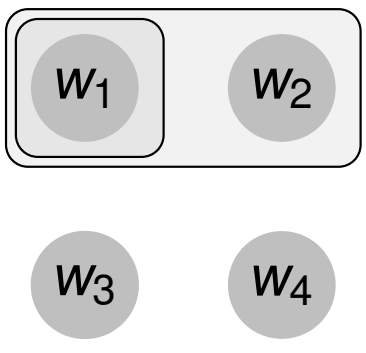
Inquisitive content

- *A* requests a response that provides enough information to establish at least one of the updates that *A* proposes
- Sometimes, it suffices to accept the information provided by *A*
- If additional information is required, we call *A* inquisitive



non-inquisitive



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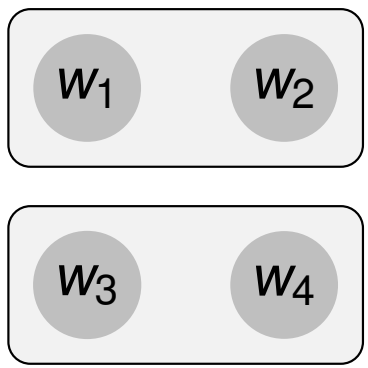
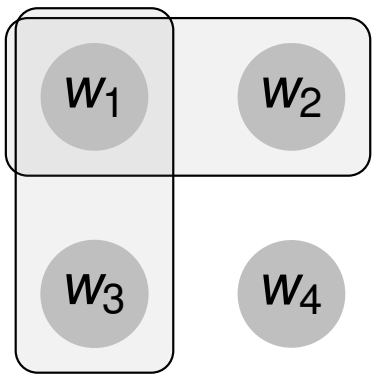
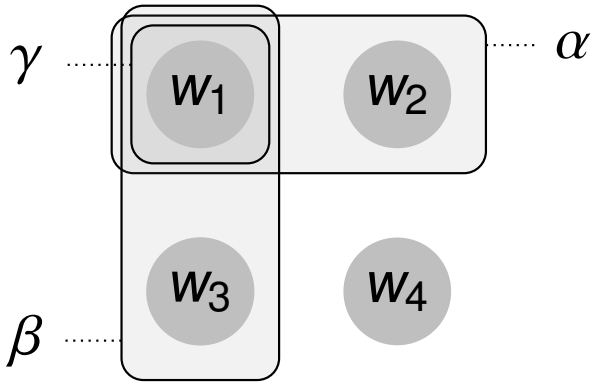


inquisitive



inquisitive

Alternative and residual possibilities

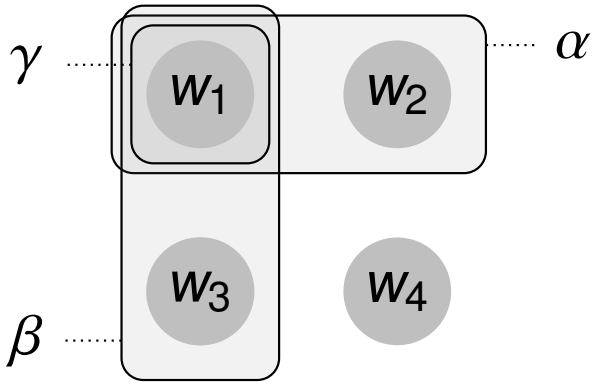


Three possibilities:

$$\begin{aligned} \alpha &= \{w_1, w_2\} \\ \beta &= \{w_1, w_3\} \\ \gamma &= \{w_1\} \end{aligned}$$

- 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 γ does not play a role in determining the informative or inquisitive content of this proposition

Alternative and residual possibilities



Three possibilities:

$$\begin{aligned} \alpha &= \{w_1, w_2\} \\ \beta &= \{w_1, w_3\} \\ \gamma &= \{w_1\} \end{aligned}$$

- In general, for any proposition A, we can distinguish:
- Alternative possibilities
  - not properly contained in a maximal possibility in A
  - completely determine informative and inquisitive content
- Residual possibilities
  - properly contained in a maximal possibility in A
  - do not play a role in capturing informative/inquisitive content

Residual possibilities

- We set out to develop a notion of semantic meaning that captures both informative and inquisitive content
- In principle, the notion of a proposition as an arbitrary set of possibilities fits this purpose
- However, it is too fine-grained: different propositions do not necessarily embody different informative or inquisitive content

Two ways to go

Restricted inquisitive semantics

- Focuses exclusively on informative and inquisitive content
- Defines propositions as sets of alternative possibilities
- I.e., residual possibilities are not taken into account

  (Groenendijk & Roelofsen 2009, Ciardelli 2009, AnderBois, 2009, 2010)

Unrestricted inquisitive semantics

- Defines propositions as arbitrary sets of possibilities
- I.e., residual possibilities are taken on board
- Besides informative and inquisitive content, propositions are taken to represent attentive content as well

  (Ciardelli, Groenendijk & Roelofsen 2009, 2010)

Unrestricted inquisitive semantics

- Besides providing and requesting information, we now think of a proposition A as drawing attention to every possibility in A
- Two propositions that provide and request exactly the same information may still draw attention to different possibilities

Pragmatic thrust of attentive content

Attentive sincerity

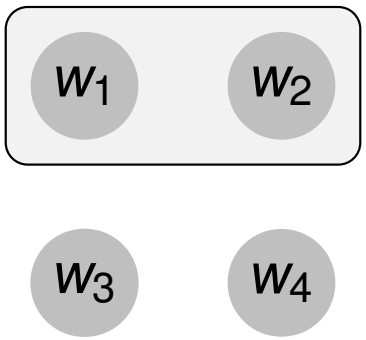
- Cooperative speakers should be attentively sincere
- That is, they should avoid drawing attention to possibilities that are inconsistent with their own information state

Licensing / safety

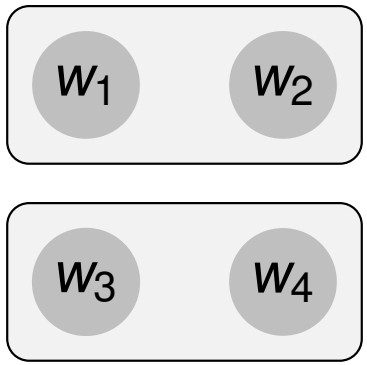
- Thus, drawing attention to a possibility α licenses any response that provides just enough information to establish α
- Such responses are safe: assuming attentive sincerity, they cannot fail to be consistent with the initiator's information state

Informative, inquisitive, and attentive propositions

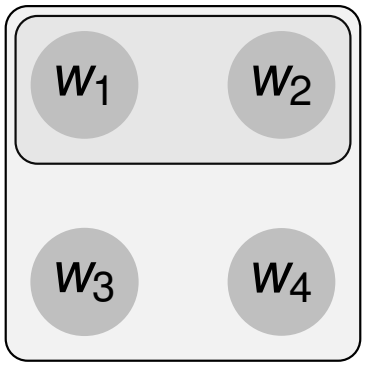
- A is informative iff it proposes to eliminate at least one world
- A is inquisitive iff it offers at least two alternative possibilities
- A is attentive iff it contains at least one residual possibility



purely informative



purely inquisitive



purely attentive

Relevance for natural language semantics

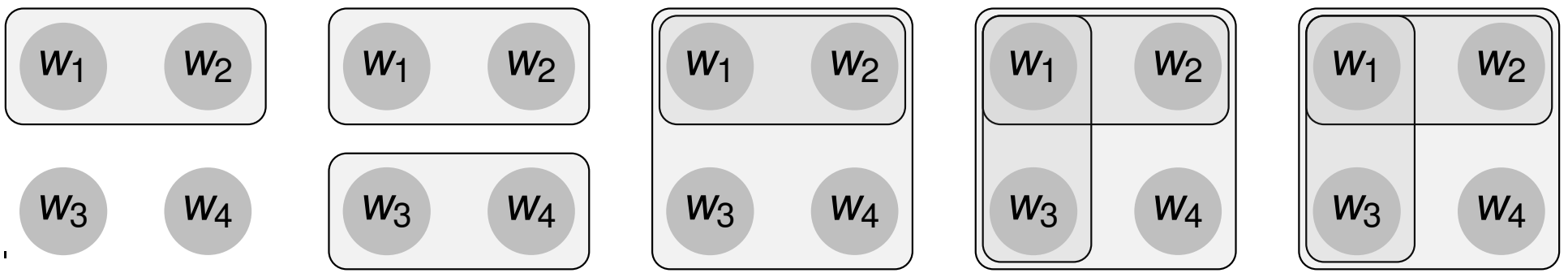
(1) John speaks Russian. informative

(2) Does John speak Russian? inquisitive

(3) John might speak Russian. attentive

(4) John might speak Russian or he might speak French. attentive

(5) John might speak Russian and he might speak French. attentive



(Ciardelli, Groenendijk & Roelofsen, 2009, 2010)

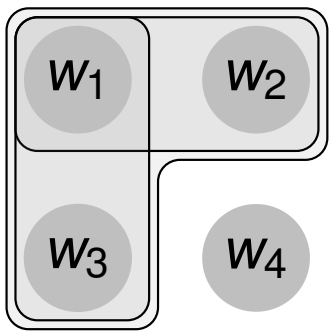
Relevance for natural language semantics

(6) John speaks Russian or French. informative & attentive

(7) Does John speak Russian-or-French↑? inquisitive & attentive

(8) John speaks Russian or he doesn't. purely attentive

(9) John speaks French or he doesn't. purely attentive



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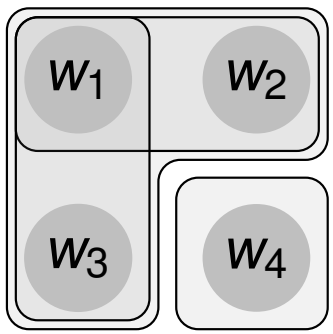

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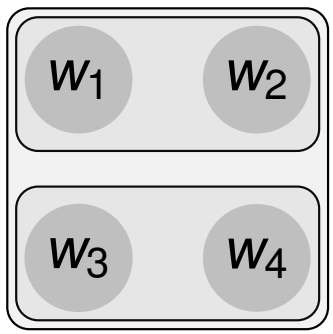

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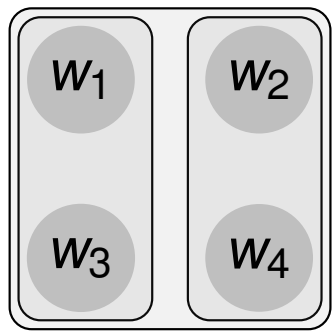
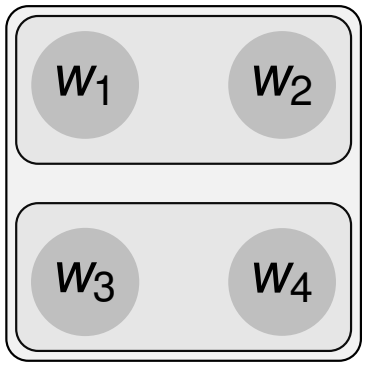


(9)

Relevance for natural language semantics

Romanian oare-questions

(10) Oare Petru a sosit deja?
oare Peter has arrived already?
'Has Peter arrived already?'



- Farkas & Bruce 2009:
  oare-questions are questions in the sense that they do not provide any information, but they differ from default questions in the sense that they do not require an informative response
- Similar phenomena in Hungarian (vajon), German (insubordinate ob), Danish (mon), ...
- Dubitatives, evidentials, ...

Overview

Semantics

- Propositions as proposals ✓
- Inquisitive algebra
- Projection operators

Logic

- Informative and inquisitive entailment
- Relatedness, compliance

Pragmatics

- Sincerity
- Transparency
- Relation

Ordering propositions, join and meet

Classically

- Propositions are ordered in terms of informative content
- $A \geq B$ iff A provides at least as much information as B
- Formally: $A \geq B \iff A \subseteq B$

Join and meet

- Relative to $\geq$, every two classical propositions have
  - a greatest lower bound (aka their meet)
  - a least upper bound (aka their join)
- The meet of two propositions amounts to their union
- The join of two propositions amounts to their intersection
- Disjunction and conjunction are usually seen as the syntactic counterparts of these semantic operations

Ordering propositions in inquisitive semantics

- In inquisitive semantics, propositions can be ordered in terms of their informative content, but also in terms of their inquisitive or attentive content, or a combination thereof
- We focus here on the case where propositions are only intended to capture informative and inquisitive content
- Thus, propositions are sets of alternative possibilities
- The order between them has an informative and an inquisitive component

Ordering propositions

- $A \geq_{\text{info}} B$ iff A provides at least as much information as B:

$$\text{info}(A) \subseteq \text{info}(B)$$

- $A \geq_{\text{inq}} B$ iff A requests at least as much information as B:

$$\forall \alpha \in A.\ \exists \beta \in B.\ \alpha \subseteq \beta$$

- $A \geq B$ if and only if $A \geq_{\text{info}} B$ and $A \geq_{\text{inq}} B$

Join and meet

- As before, relative to $\geq$, every two propositions have
  - a greatest lower bound (aka their meet)
  - a least upper bound (aka their join)
- To determine the meet of two propositions, we first take their union, and then filter out residual possibilities:

$$\textsc{meet}(A, B) = \textsc{alt}(A \cup B)$$

- To determine the join of two propositions, we first take their pointwise intersection (denoted by $\sqcap$), and then filter out residual possibilities:

$$\textsc{join}(A, B) = \textsc{alt}(A \sqcap B)$$

- Disjunction and conjunction can still be seen as the syntactic counterparts of these semantic operations

$\langle \Sigma, \geq \rangle$ is not a Boolean algebra

- The existence of meets and joins implies that the set of all propositions Σ, together with the order $\geq$, forms a lattice
- Moreover, Σ has:
  - a smallest element, $\top = \{W\}$
  - a greatest element, $\bot = \{\emptyset\}$
- This means that $\langle \Sigma, \geq \rangle$ forms a bounded lattice
- However, notably, $\langle \Sigma, \geq \rangle$ does not form a Boolean algebra
- That is, not every $A \in \Sigma$ has a complement B such that:

$$\begin{aligned} \textsc{meet}(A, B) &= \top \\ \textsc{join}(A, B) &= \bot \end{aligned}$$

$\langle \Sigma, \geq \rangle$ is a Heyting algebra

- We do have that for every two propositions A, B there is a unique $\geq$-minimal proposition C such that $\textsc{join}(A, C) \geq B$
- This proposition C is called the relative pseudo-complement of A with respect to B, and is denoted as:

$$A \rightsquigarrow B$$

- The existence of relative pseudo-complements implies that $\langle \Sigma, \geq \rangle$ forms a Heyting algebra
- The (non-relative) pseudo-complement of A is defined as:

$$\sim A \quad := \quad A \rightsquigarrow \bot$$

- Implication and negation could be seen as the syntactic counterparts of $\rightsquigarrow$ and $\sim$, respectively

Relevance for natural language semantics

- Disjunction (MEET) is a source of inquisitiveness
- This provides the basis for an explanation of the disjunctive-interrogative affinity observed cross-linguistically

(11) We eten vanavond boerenkool of hutspot.
We eat tonight boerenkool or hutspot.
'We will eat boerenkool or hutspot tonight.'

(12) Maria weet of we vanavond hutspot eten.
Maria knows or we tonight hutspot eat.
'Maria knows whether we will eat hutspot tonight.'

- See AnderBois (2009, 2010) on Yukatec Maya and Haida (2009, 2010) on Chadic languages

Relevance for natural language semantics

- Disjunction (MEET) is a source of inquisitiveness
- This facilitates a perspicuous account of sluicing

(13) Fred works for a big software company, I don't remember which.

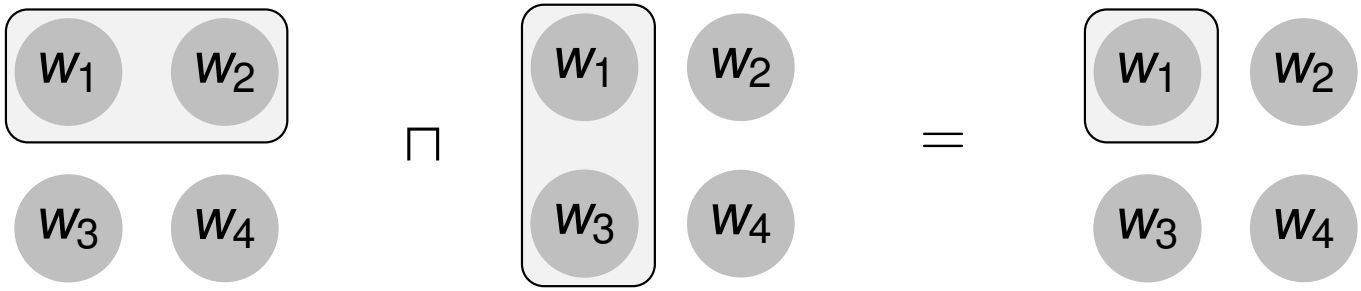
(14) Fred works for Oracle, IBM, or Adobe, I don't remember which.

- See AnderBois (2010)

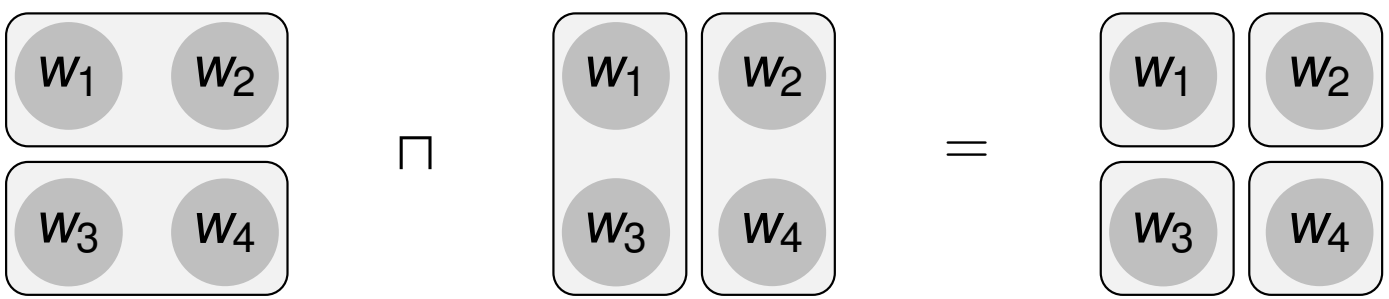
Relevance for natural language semantics

Conjunction (JOIN) applies uniformly to questions and assertions

(15) John speaks Russian and he speaks French.



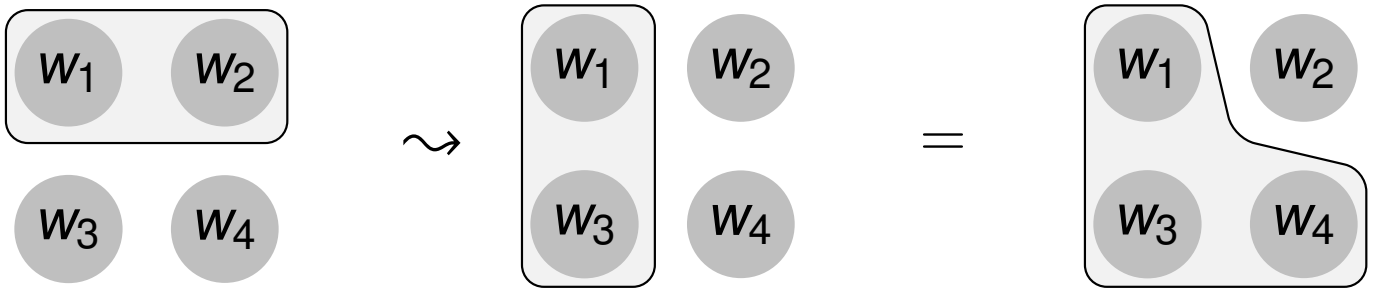
(16) Does John speak Russian, and does he speak French?



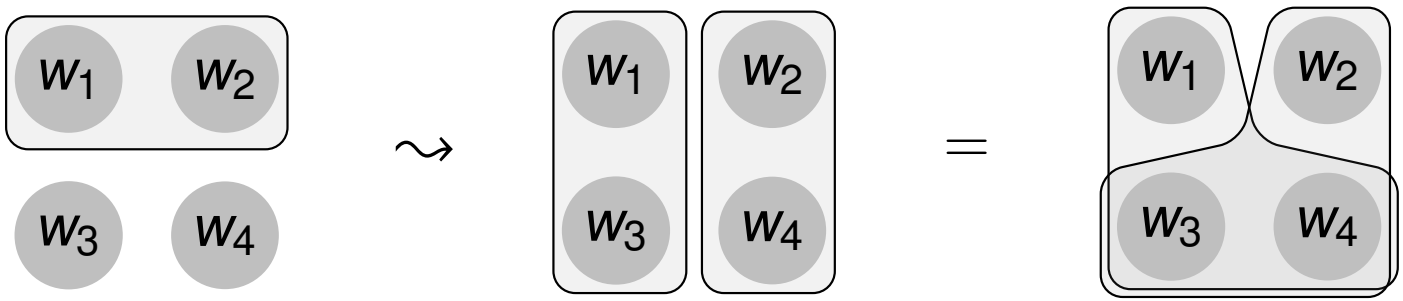
Relevance for natural language semantics

Implication ($\rightsquigarrow$) applies uniformly to questions and assertions

(17) If John will go to the party, Mary will go as well.



(18) If John will go to the party, will Mary go as well?



Relevance for natural language semantics

Conditional questions with disjunctive antecedents

(19) If John or Fred goes to the party, will Mary go as well?

There are four possibilities for this sentence,
corresponding to the following responses:

(20)
a. Yes, if John or Fred goes, Mary will go as well.
b. No, if John or Fred goes, Mary won't go.
c. If J goes, M will go as well, but if F goes, M won't go.
d. If F goes, M will go as well, but if J goes, M won't go.

Overview

Semantics

- Propositions as proposals ✓
- Inquisitive algebra ✓
- Projection operators

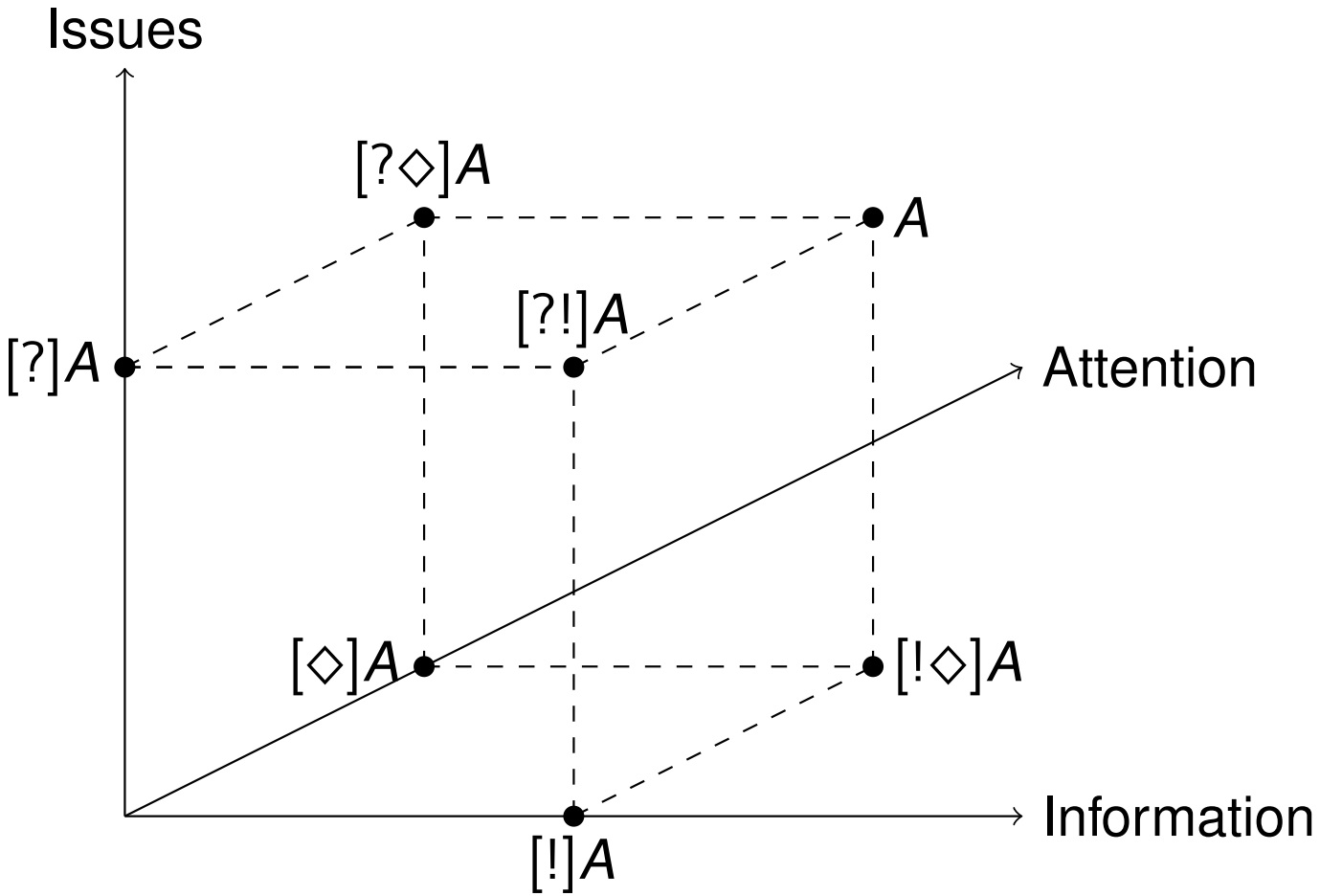
Logic

- Informative and inquisitive entailment
- Relatedness, compliance

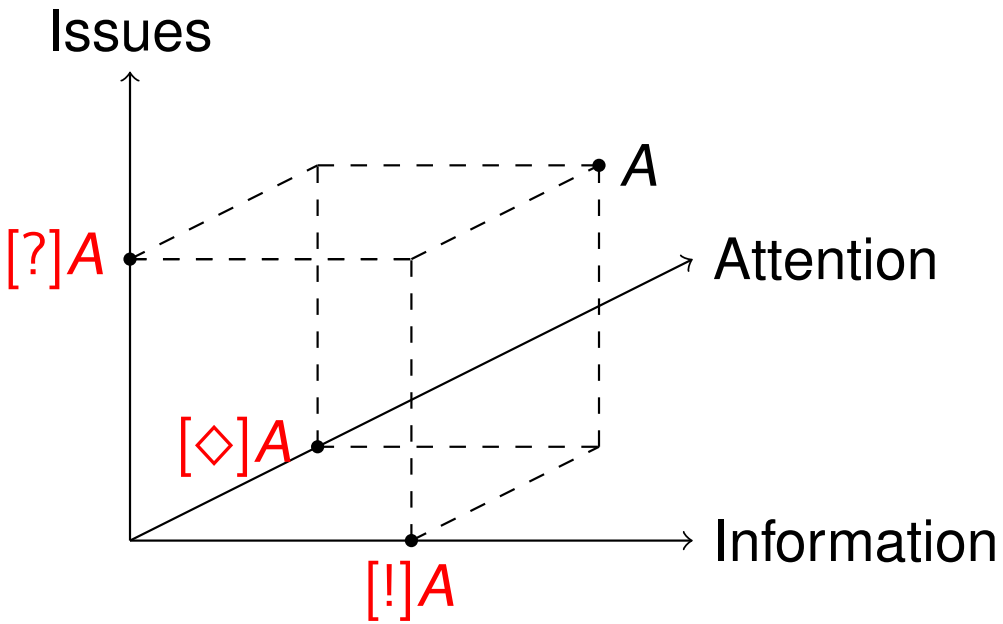
Pragmatics

- Sincerity
- Transparency
- Relation

Projection operators

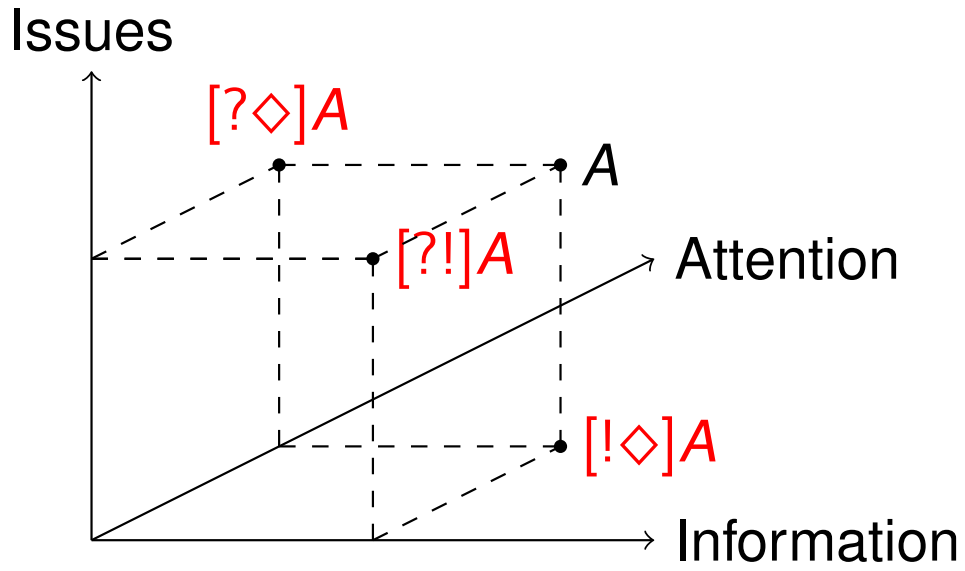


Projections onto the axes



$[!]A$	purely informative projection
$[?]A$	purely inquisitive projection
$[\diamond]A$	purely attentive projection

Projections onto the planes



$[?\diamond]A$ non-informative projection
$[!\diamond]A$ non-inquisitive projection
$[?!]A$ non-attentive projection

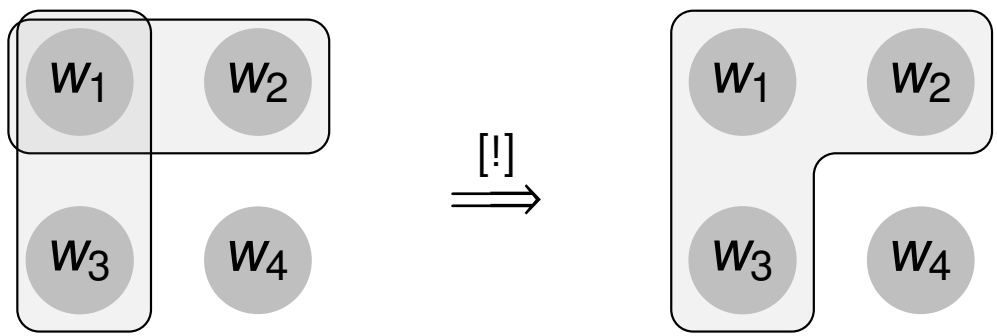
Example: purely informative projection

Requirements

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

Implementation

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



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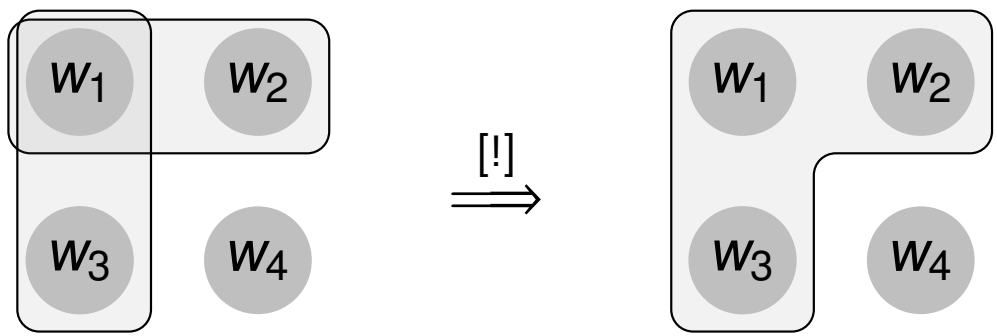


$\approx$ 'existential closure' in alternative semantics

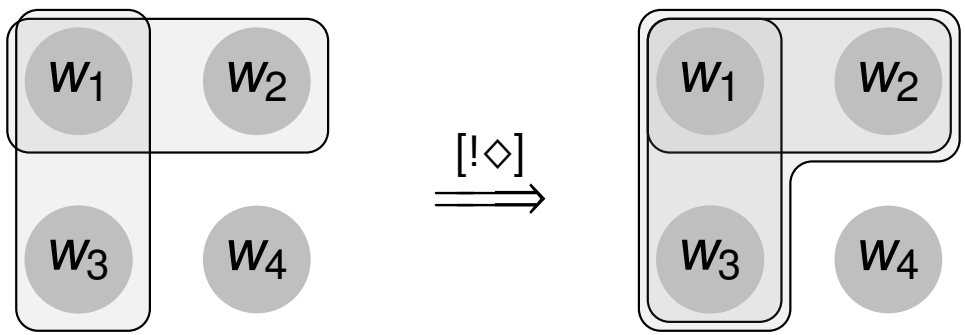
Another example: non-inquisitive projection

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

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



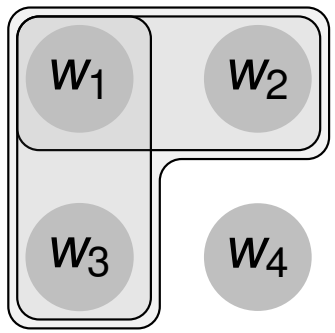
Relevance for natural language semantics

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

Earlier example:

(6) John speaks Russian or French.

[C_{-Q} John speaks [Russian or French]]



- Informative and attentive, but not inquisitive
- Alternatives introduced by disjunction, but closed off by C_{-Q}

Overview

Semantics

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Pragmatics

- Sincerity
- Transparency
- Relation

Logic

Traditionally

- logic is concerned with entailment and (in)consistency
- given these concerns, it makes sense to identify semantic meaning with informative content

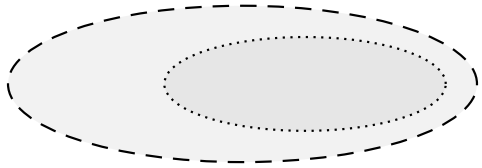
Vice versa

- if semantic meaning is identified with informative content, and propositions are construed as sets of possible worlds
- then there are only three possible relations between two propositions: inclusion, overlap, and disjointness
- these correspond to entailment and (in)consistency
- other relations between propositions cannot be captured

Entailment and (in)consistency

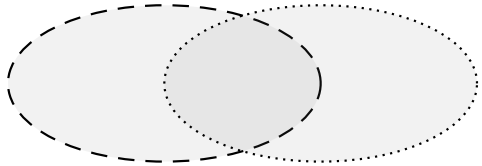
If propositions are construed as sets of possible worlds then two propositions can only be related in one of the following three ways

inclusion



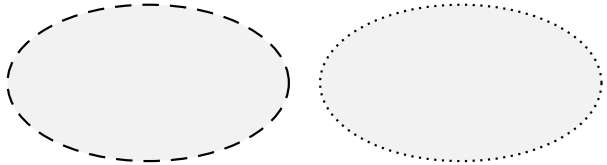
entailment

overlap



consistency

disjointness



inconsistency

Inquisitive logic

A new perspective

- Enriching the notion of semantic meaning leads to a new perspective on logic as well

New logical notions

- Besides classical entailment, we get a notion of inquisitive entailment: φ inquisitively entails ψ iff whenever φ is resolved, ψ is resolved as well

  (Groenendijk & Roelofsen 2009, Ciardelli & Roelofsen 2011)

- We also get logical notions of relatedness. In particular, φ is a compliant response to ψ iff it addresses the proposal expressed by ψ without providing any redundant information.

  (Groenendijk & Roelofsen 2009, Cornelisse et.al. 2009)

Inquisitive logic

A new perspective

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New logical notions

- Besides classical entailment, we get a notion of inquisitive entailment: φ inquisitively entails ψ iff whenever φ is resolved, ψ is resolved as well
- We also get logical notions of relatedness. In particular, φ is a compliant response to ψ iff it addresses the proposal expressed by ψ without providing any redundant information.

Note: classical notions are preserved; the logical agenda is extended, not revised (compare, e.g., with intuitionistic logic)

Pragmatics

Pragmatics specifies how cooperative speakers should use the sentences of a language, given a particular context and the semantic meaning of those sentences

Classical (Gricean) pragmatics

- identifies semantic meaning with informative content
- is speaker-oriented

- Quality: say only what you believe to be true
- Quantity: be as informative as possible
- Relation: say only things that are relevant for the purposes of the conversation

Inquisitive pragmatics

A new perspective

- Enriching the notion of semantic meaning leads to a new perspective on pragmatics as well

Inquisitive pragmatics

- based on informative, but also inquisitive/attentive content
- speaker-oriented, but also hearer-oriented

- Sincerity: only say what you know, only ask what you don't know, only draw attention to possibilities compatible with what you know
- Transparency: publicly announce unacceptability of a proposal
- Relation: compliantly address previous proposals

Conclusion

- The main purpose of inquisitive semantics is to develop a new notion of semantic meaning that captures both informative and inquisitive content
- Propositions are defined as sets of possibilities, representing proposals to update the common ground in one or more ways
- These new type of propositions are ordered in a natural way, based on their informative and inquisitive content
- This order yields algebraic operators like JOIN, MEET, $\rightsquigarrow$, and $\sim$
- The new conception of propositions also naturally gives rise to projection operators like [?] and [!]
- These algebraic operators and projection operators could be related to connectives and complementizers in formal and natural languages

Conclusion

- Changing the basic notion of semantic meaning gives rise to a new perspective on logic
- Besides informative entailment and consistency, new logical notions like inquisitive entailment and compliance enter the picture
- Changing the basic notion of semantic meaning also changes our perspective on pragmatics
- Speakers should not only be informatively sincere, but also inquisitively and attentively sincere
- Responders should be transparent and make a contribution that is related to previous proposals

Thank you

Netherlands Organisation for Scientific Research

www.illc.uva.nl/inquisitive-semantics

Some references

Inquisitive semantics and pragmatics

Jeroen Groenendijk and Floris Roelofsen (2009)
Stanford workshop on Language, Communication and Rational Agency

Inquisitive logic

Ivano Ciardelli and Floris Roelofsen (2011)
Journal of Philosophical Logic 40(1), 55–94.

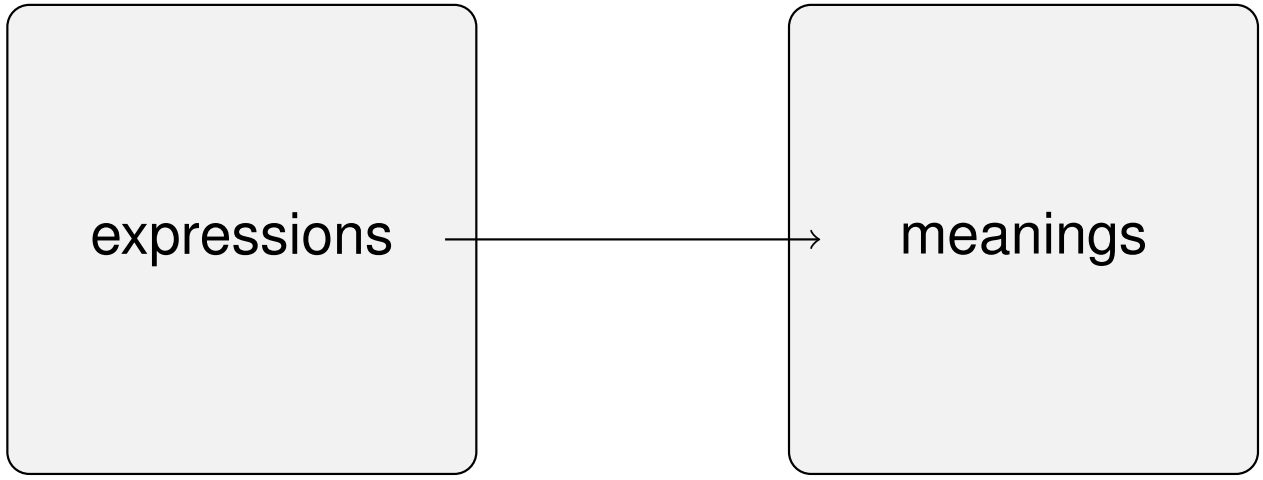
Information, issues, and attention

Ivano Ciardelli, Jeroen Groenendijk and Floris Roelofsen (2010)
In progress, latest version available at:

www.illc.uva.nl/inquisitive-semantics

Appendix: framework versus theories

- Natural language semantics seeks to assign appropriate meanings to linguistic expressions in a systematic way



- The work presented here focused on developing a richer space of meanings, and investigating the properties of these meanings, independently of the expressions in natural language that they may be assigned to
- This work suggests a certain semantic treatment of connectives and complementizers

Appendix: framework versus theories

- However, first and foremost, it establishes a framework for natural language semantics, leaving many options open as to how the expressions of concrete natural languages should be mapped to the enriched meanings
- To illustrate this point, consider the case of *wh*-questions
- Inquisitive semantics, qua framework, does not make any claims about the proper semantic analysis of *wh*-questions
- It offers a general framework to capture inquisitive content
- Hamblin's, Karttunen's, and Groenendijk & Stokhof's theories can all be expressed and compared in this framework
- The framework as such does not favor any of these theories