

Semantic Theory

Week 11 – Current issues in Semantic Theory

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Semantic Theory

Topics covered in this course:

Predicate logic - Type Theory - Lambda Calculus -
Generalised Quantifiers - Event Semantics - Dynamic
Semantics - Discourse Representation Theory -
Presuppositions - Distributional Formal Semantics



formal semantics

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Open questions

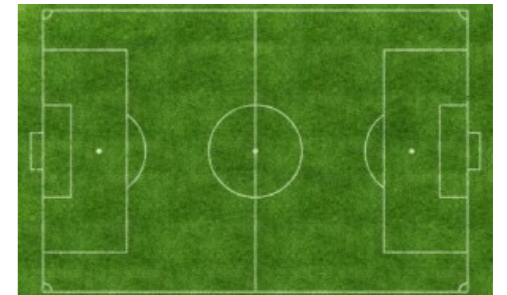
I. How to formalise meaning?

Truth-conditions vs. context-change potential
vs. answering the Question Under Discussion



II. Which phenomena should be captured by a semantic formalism?

Syntax vs. Semantics vs. Pragmatics



III. How to validate predictions from formal semantic theories?

Experimental approaches, Computational Semantics



Communication as question-answering



The Goal of communication: to determine what the world is like.

But: an exhaustive characterisation of the current state of the world – “The Big Question” (Roberts, 1996) – is too big a task

- What makes certain issues more important to us than others has to do with our goals
- ? Therefore, we establish certain subgoals, which take the form of issues to be resolved or Questions Under Discussion (QUDs)
- Content that addresses the QUD is called *at-issue* content; all other content is *not at-issue*

Inquisitive semantics

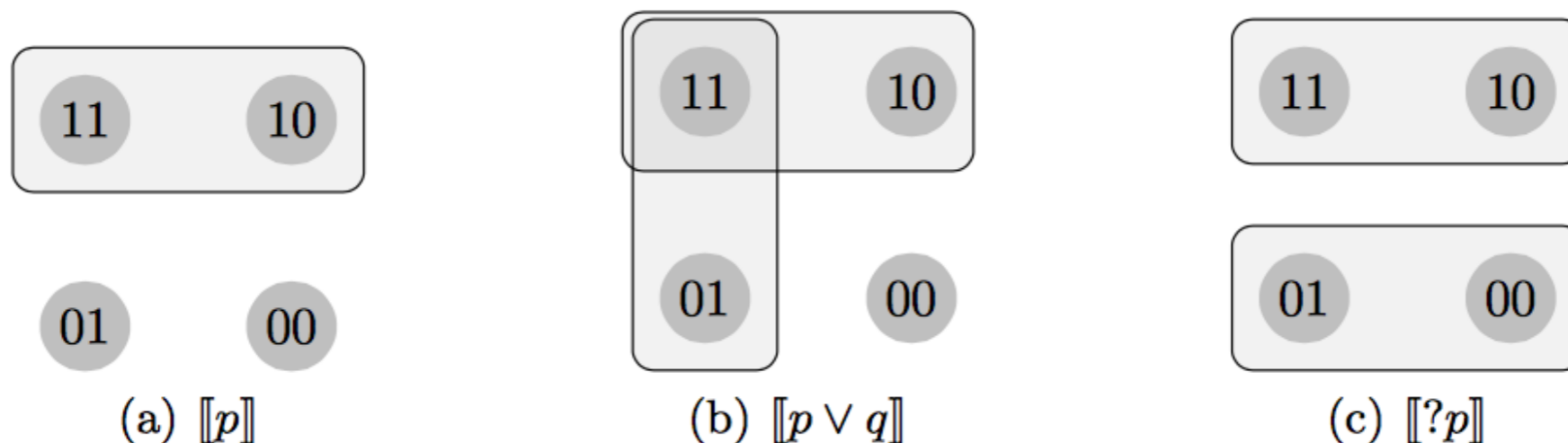


“Meaning is Information EXchange Potential”

(1) $\llbracket \text{John plays} \rrbracket^{M,w,g} := \{\lambda v. \text{play}(\text{John})(v)\} :: \langle s, t \rangle$

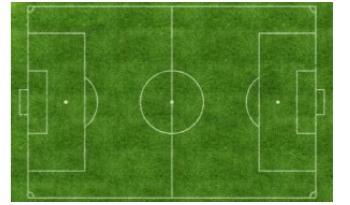
(2) $\llbracket \text{John or Bill plays} \rrbracket^{M,w,g} := \{\lambda v. \text{play}(\text{John})(v), \lambda v. \text{play}(\text{Bill})(v)\}$

(3) $\llbracket \text{Does John play?} \rrbracket^{M,w,g} := \{\lambda v. \text{play}(\text{John})(v), \lambda v. \neg \text{play}(\text{John})(v)\}$



(Groenendijk, 2009; Groenendijk & Roelofsen, 2009)

Defining the playing field of semantic theory



What can/should be captured in a semantic formalism?

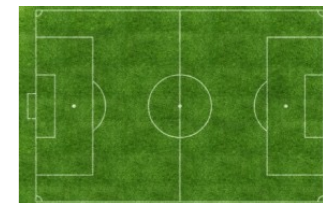
The syntax-semantics interface:

- quantification, anaphora, tense and aspect, thematic roles, ...

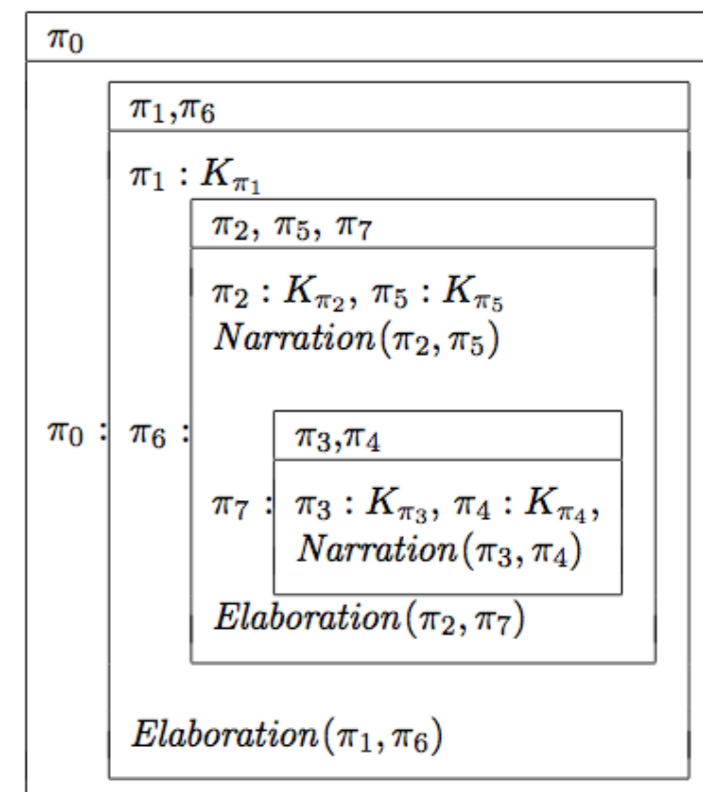
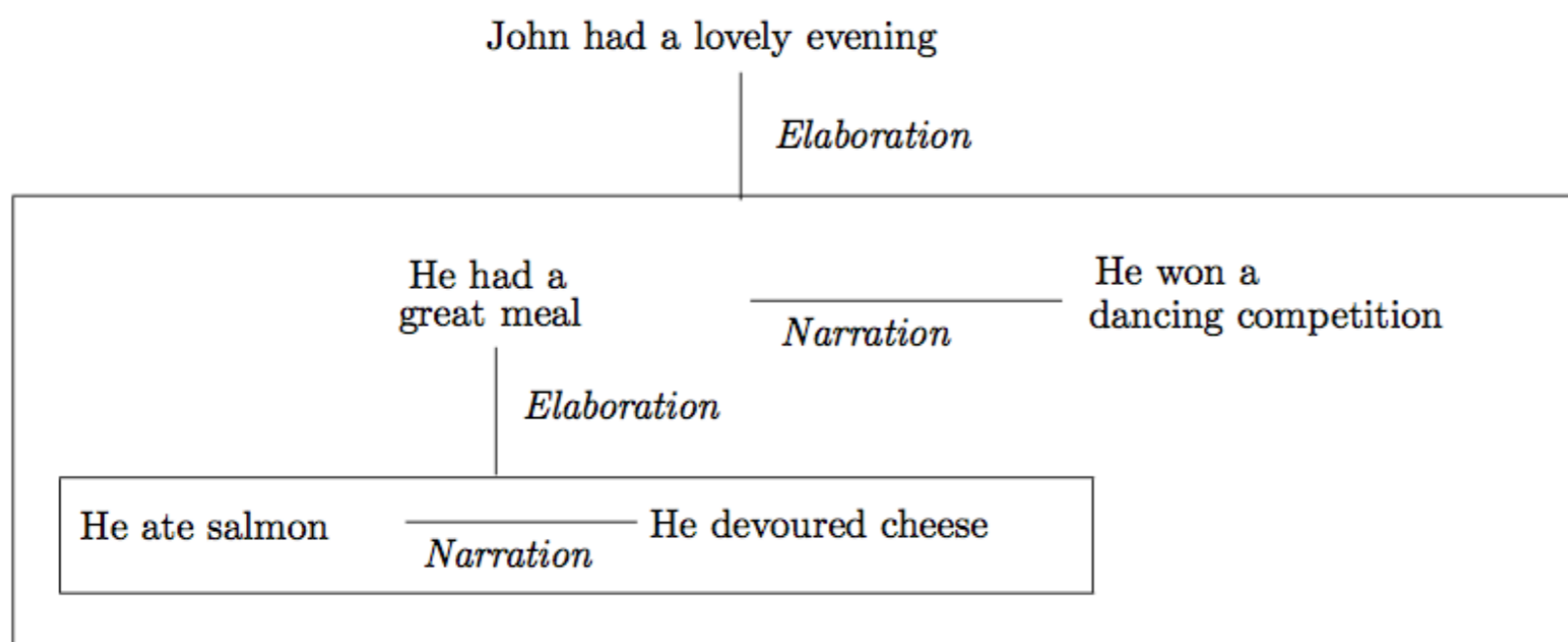
The semantics-pragmatics interface:

- rhetorical structure, implicature, presuppositions, information structure, ...

Beyond truth-conditional meaning: Rhetorical Structure



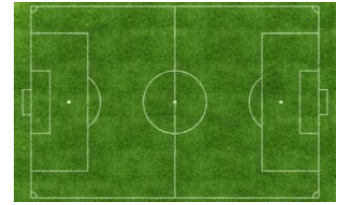
(1) *John had a great evening last night. He had a great meal. He ate salmon. He devoured lots of cheese. He won a dancing competition. ??It was a beautiful pink.*



Segmented DRT: DRT with discourse relations

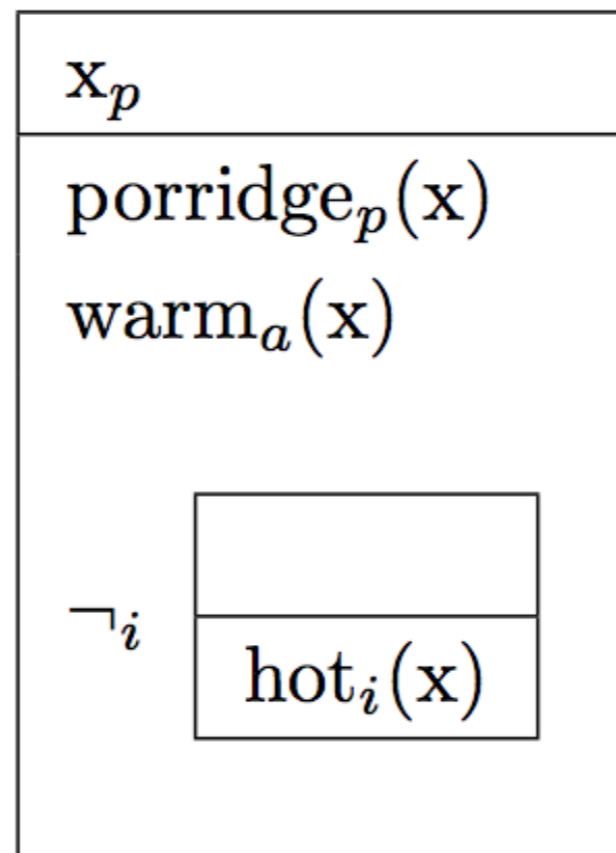
(Asher, 1992; Asher & Lascarides, 2003)

Beyond truth-conditional meaning: Implicature

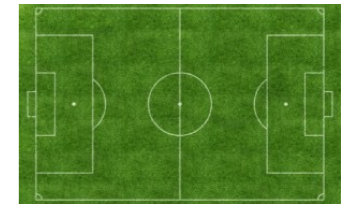


- (1) a. The porridge is warm. As a matter of fact, it is hot.
b. ?The porridge is warm. As a matter of fact, it is cold.

Layered DRT: DRT with multiple layers of meaning



Beyond truth-conditional meaning: Information structure



- (1) John has a sister. He visits her every week. → *assertion*
- (2) John visits his sister every week. → *presupposition*
- (3) John, who has a sister, visits her every week → *conventional implicature*

Projective Discourse Representation Theory (PDRT):
DRT with information structure

1
2 ← x 3 ← y
2 ← x=john
3 ← sister(y)
3 ← of(y,x)
1 ← visit_weekly(x,y)
1 ≤ 2 1 < 3 3 = 2

Venhuizen, 2015; Venhuizen et al. 2018

Formal semantics in the real world



How to apply and evaluate formal linguistic theories?

⇒ Using implementations of semantic formalisms to perform (large-scale) computational semantic analyses

- PDRT-Sandbox (Brouwer & Venhuizen, 2013); Boxer (Bos, 2008)
- The Groningen Meaning Bank (Basile et al., 2013; Bos et al., 2017)

⇐ Testing predictions from formal semantic theories using psycholinguistic methods (questionnaires, eye-tracking, EEG)

- Geurts et al. (2010); Chemla et al. (2011); Florian Schwarz (ed., 2015), ...

Neurocomputational modeling with DFS



Surprisal and Entropy estimates derive from navigating $S_{M \times P}$

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Expectation-based Comprehension: Modeling the Interaction of World Knowledge and Linguistic Experience

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ABSTRACT

The processing difficulty of each word is affected by both our prior linguistic experience about the world. Computational modeling has, however, been limited in accounting for world knowledge. We develop an incremental model that constructs—on a word-by-word basis—representations of the world. To quantify linguistic surprisal, we propose a model that integrates linguistic experience and world knowledge at the level of interpretation and combines them in determining online expectations. Here, we extend this work by deriving a comprehension-centric metric of entropy reduction from this model. In contrast to previous work, which has found that surprisal and entropy reduction are not easily dissociated, we do find a clear dissociation in our model. While both surprisal and entropy reduction derive from the same cognitive process—the word-by-word updating of the unfolding interpretation—they reflect different aspects of this process: state-by-state expectation (surprisal) versus end-state confirmation (entropy reduction).



Article

Semantic Entropy in Language Comprehension

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Abstract: Language is processed on a more or less word-by-word basis, and the processing difficulty induced by each word is affected by our prior linguistic experience as well as our general knowledge about the world. Surprisal and entropy reduction have been independently proposed as linking theories between word processing difficulty and probabilistic language models. Extant models, however, are typically limited to capturing linguistic experience and hence cannot account for the influence of world knowledge. A recent comprehension model by Venhuizen, Crocker, and Brouwer (2019, *Discourse Processes*) improves upon this situation by instantiating a comprehension-centric metric of surprisal that integrates linguistic experience and world knowledge at the level of interpretation and combines them in determining online expectations. Here, we extend this work by deriving a comprehension-centric metric of entropy reduction from this model. In contrast to previous work, which has found that surprisal and entropy reduction are not easily dissociated, we do find a clear dissociation in our model. While both surprisal and entropy reduction derive from the same cognitive process—the word-by-word updating of the unfolding interpretation—they reflect different aspects of this process: state-by-state expectation (surprisal) versus end-state confirmation (entropy reduction).

