Semantic Theory
Week 10 – Current issues in Semantic Theory

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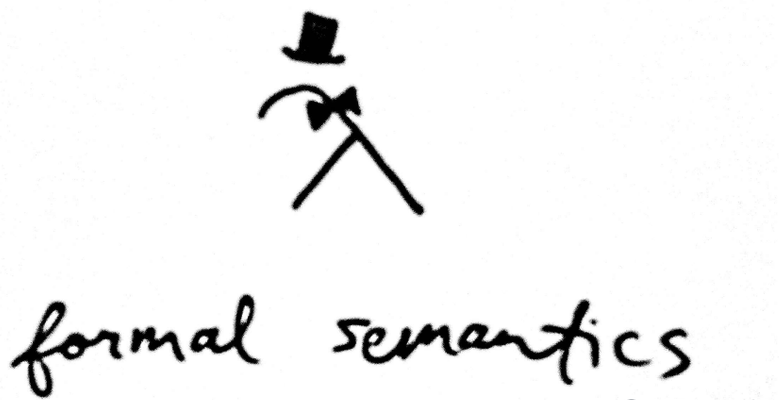
Semantic Theory

Topics covered in this course:

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



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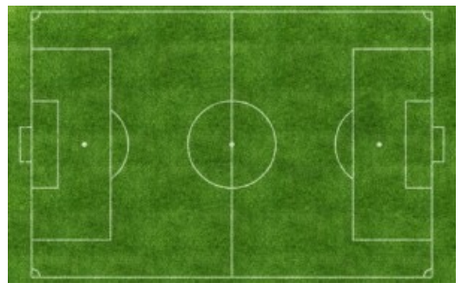
Open questions

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*

Roberts, 1996; 2012; Simons et al. 2010; Tonhauser et al. 2013

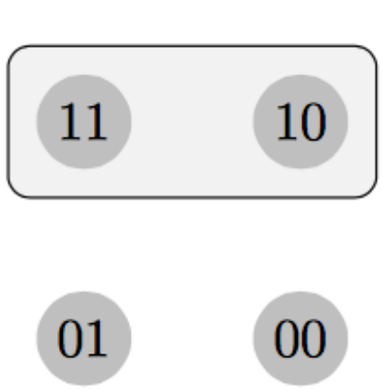
Inquisitive semantics

“Meaning is Information EXchange Potential”

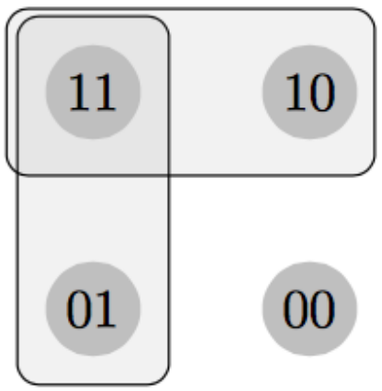
(1) $[\![\text{John plays}]\!]^{M,w,g} := \{\lambda v.\text{play}(\text{John})(v)\} :: \langle s, t\rangle$

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

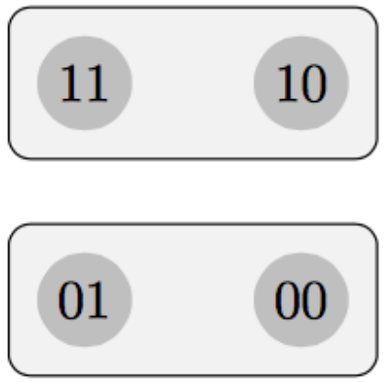
(3) $[\![\text{Does John play?}]\!]^{M,w,g} := \{\lambda v.\text{play}(\text{John})(v), \lambda v.\neg\text{play}(\text{John})(v)\}$



(a) $[\![p]\!]$



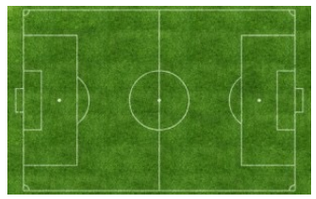
(b) $[\![p \vee q]\!]$



(c) $[\![?p]\!]$

(Groenendijk, 2009; Groenendijk & Roelofsen, 2009)

Defining the playing field of semantic theory



What can/should be captured in a semantic formalism?

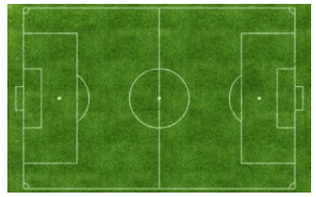
The syntax-semantics interface:

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

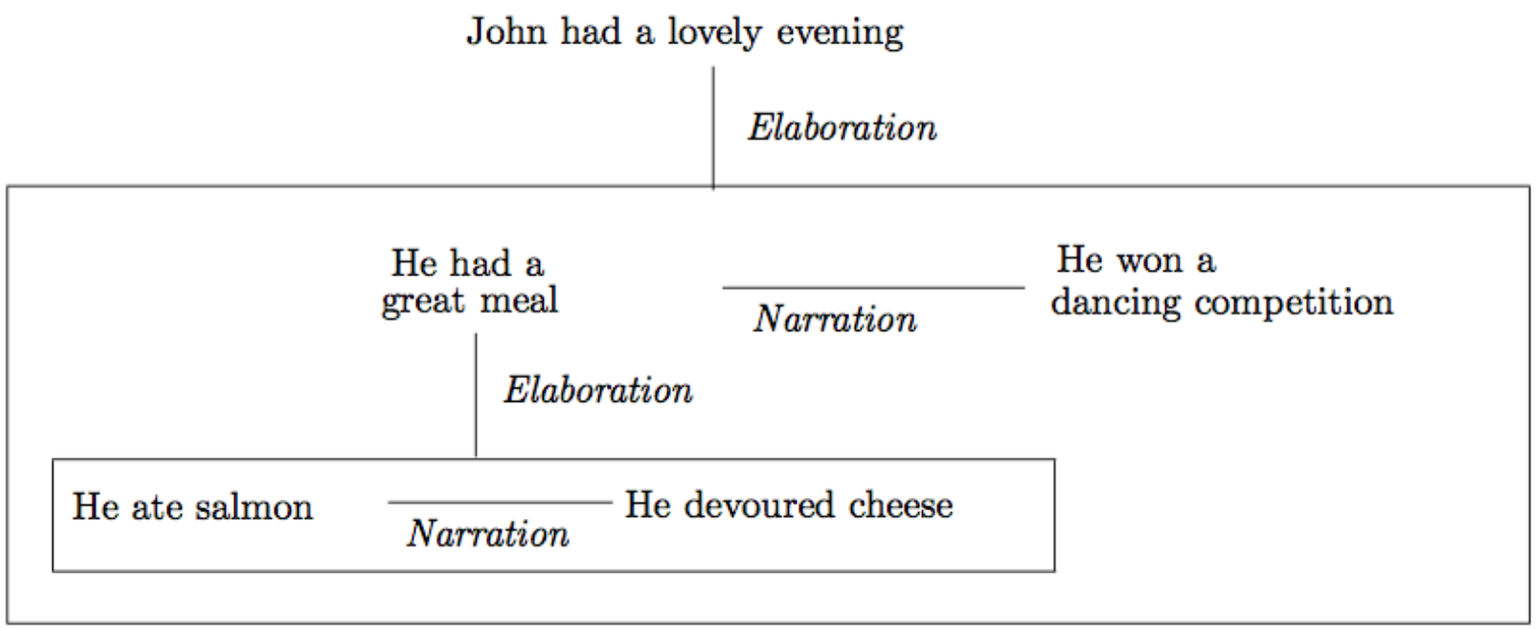
The semantics-pragmatics interface:

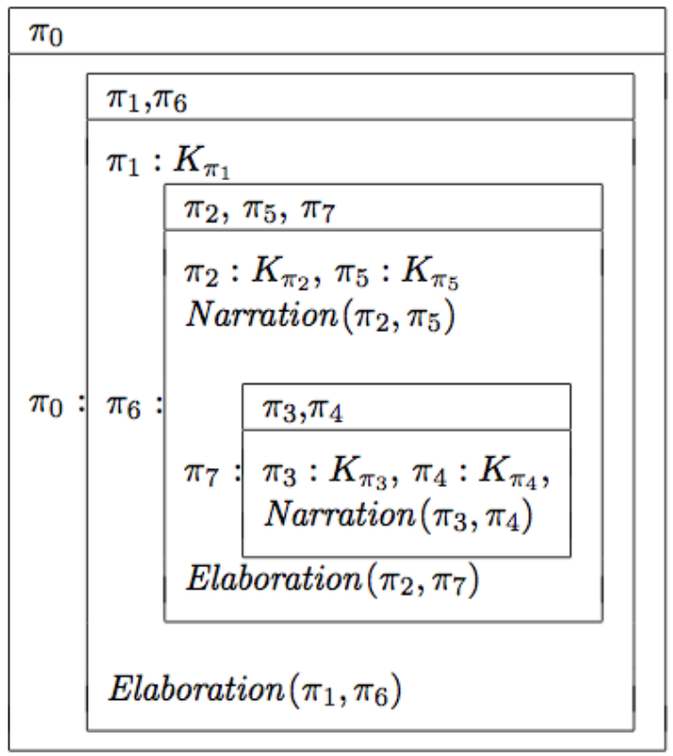
- rhetorical structure, implicature, presuppositions, information structure, …

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.

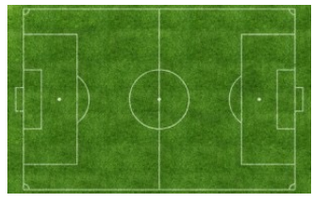




Segmented DRT: DRT with discourse relations

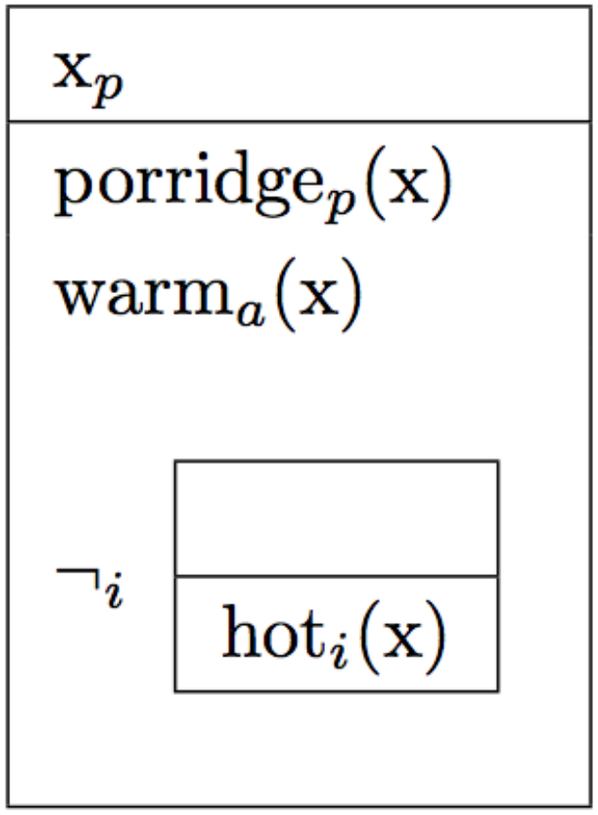
(Asher, 1992; Asher & Lascarides, 2003)

Beyond truth-conditional meaning: Implicature



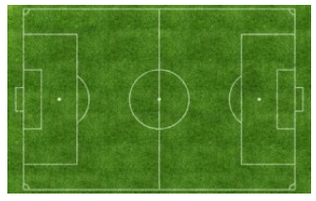
(1) a. The porridge is warm. As a matter of fact, it is hot.
b. ?The porridge is warm. As a matter of fact, it is cold.

Layered DRT: DRT with multiple layers of meaning



Geurts & Maier 2003; 2013

Beyond truth-conditional meaning: Information structure

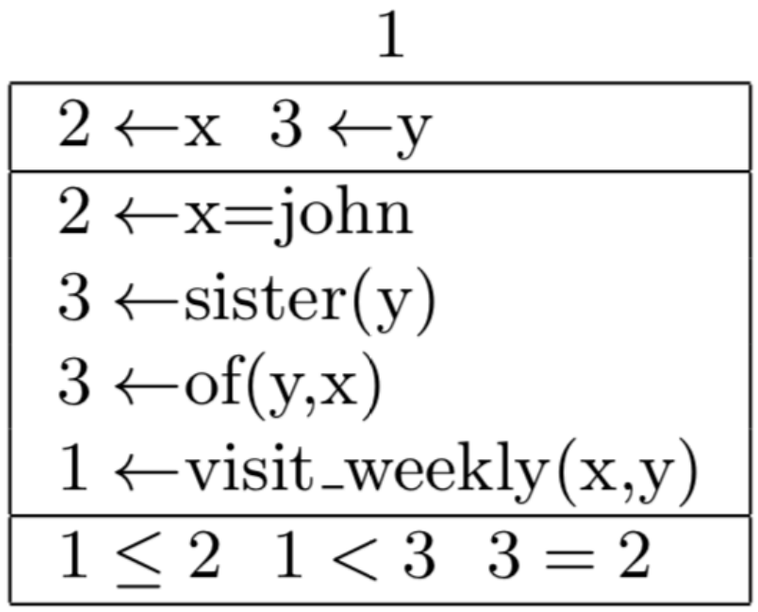


(1) John <u>has a sister</u>. He visits her every week. → assertion

(2) John visits <u>his sister</u> every week. → presupposition

(3) John, <u>who has a sister</u>, visits her every week → conventional implicature

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



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), …

Groningen Meaning Bank

Corpus of semantically annotated texts – with (P)DRSs!

Groningen MEANING BANK 77/0696 Search Log in

metadata raw tokens sentences discourse 9 bits of wisdom 0 warnings

Show: pointers

b1

k1 :: b1 ← x1 b1 ← e1 b1 ← x2 b1 ← s1 b1 ← p1 b1 ← e2 b1 ← s2 b2 ← t1 b1 ← t2

b1 ← eagle(x1)
b1 ← wound(e1)
b1 ← Experiencer(e1, x1)
b1 ← archer(x2)
b1 ← Agent(e1, x2)
b1 ← Manner(e1, s1)
b1 ← mortal(s1)

b3

b1 ← p1: b3 ← p2 b3 ← e3

b5

b3 ← p2: b4 ← x3 b5 ← e4 b5 ← x4 b1 ← x1 b1 ← x5 b1 ← s3 b2 ← t1 b5 ← t3

b4 ← arrow(x3)
b5 ← feather(e4)
b5 ← Destination(e4, x3)
b5 ← |x4| = 1
b5 ← thing(x4)
b1 ← male(x1)
b1 ← of(x5, x1)
b1 ← Theme(s3, x5)
b1 ← own(s3)
b1 ← quill(x5)
b5 ← of(x4, x5)
b5 ← Patient(e4, x4)
b2 ← now(t1)
b5 ← e4 ⊆ t3
b5 ← t3 < t1

b3 ← observe(e3)
b3 ← Agent(e3, x1)
b3 ← Theme(e3, p2)

b1 ← comfort(e2)
b1 ← Topic(e2, x1)
b1 ← Recipient(e2, p1)
b1 ← Manner(e2, s2)
b1 ← great(s2)
b2 ← now(t1)
b1 ← e2 ⊆ t2
b1 ← t2 < t1

co… k1, k2

b6

k2 ::

b7

b6 ← □ b1 ← x1 b1 ← x1 b7 ← e5 b7 ← p3 b2 ← t1 b7 ← t4 b7 ← p4 b2 ← t1 b7 ← t5

b1 ← person(x1)
b1 ← male(x1)
b7 ← say(e5)
b7 ← Cause(e5, x1)
b7 ← Topic(e5, p3)

b8

b7 ← p3: b1 ← x1 b8 ← e6 b8 ← s4 b8 ← s5

b1 ← person(x1)
b8 ← feel(e6)
b8 ← Agent(e6, x1)
b8 ← Manner(e6, s4)
b8 ← bad(s4)
b8 ← Manner(e6, s5)
b8 ← indeed(s5)

b2 ← now(t1)
b7 ← e5 ⊆ t4
b7 ← t4 < t1

b9

b7 ← p4: b9 ← p5 b9 ← e7

b10

b9 ← p5:

b11 b13

b10 ← b11 ← x6 b1 ← x1 ⇒ b13 ← x7 b13 ← e8 b2 ← t1 b13 ← t6 b1 ← x1

b11 ← eagle(x6)
b1 ← eagle(x1)
b13 ← hand(x7)
b13 ← have(e8)
b13 ← Agent(e8, x6)

b12

b11 ← ¬

b12 ← x6

b13 ← thing(x1)
b13 ← in(e8, x1)

b9 ← think(e7)
b9 ← Agent(e7, x1)
b9 ← Theme(e7, p5)

b7 ← Topic(e5, p4)
b2 ← now(t1)
b7 ← e5 ⊆ t5
b7 ← t1 < t5

Groningen MEANING BANK

Parallel MEANING BANK

Neurocomputational modeling with DFS

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

DISCOURSE PROCESSES
2019, VOL. 56, NO. 3, 229–255
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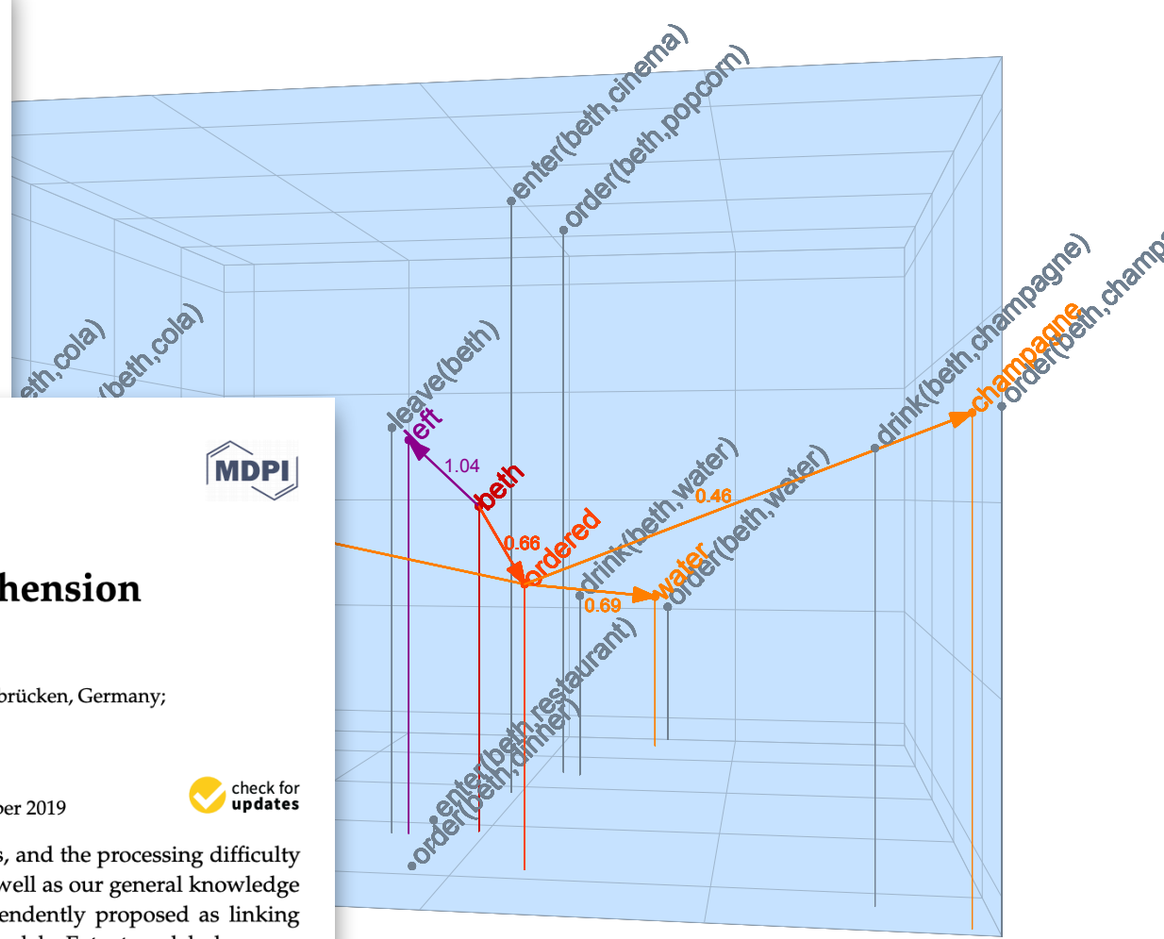
Expectation-based Comprehension: Modeling the Interaction of World Knowledge and Linguistic Experience

Noortje J. Venhuizen, Matthew W. Crocker, and Harm Brouwer

Saarland University, Saarbrücken, Germany

ABSTRACT

The processing difficulty of each wo
affected by both our prior linguistic exp
about the world. Computational mode
sing have, however, been limited in ac
knowledge. We develop an incremental
that constructs—on a word-by-word
model representations. To quantify lin
Surprisal Theory, which asserts that the
word is inversely proportional to its exp
contrast with typical *language model*
proposed model instantiates a novel c
prisal that reflects the likelihood of th
established after processing each wo
demonstrate that linguistic experience a
in the model at the level of interpret
online expectations.



entropy

MDPI

Article

Semantic Entropy in Language Comprehension

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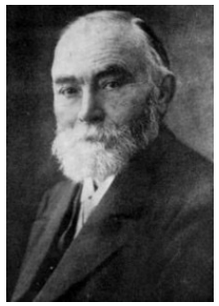
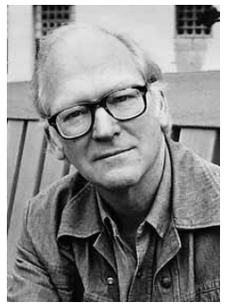
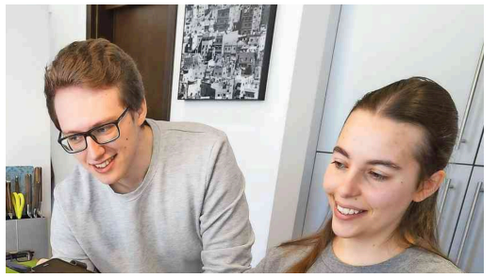
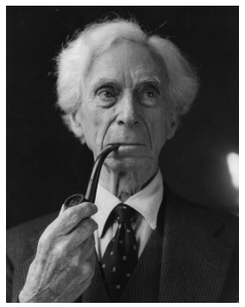
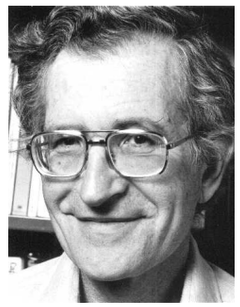
check for updates

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).

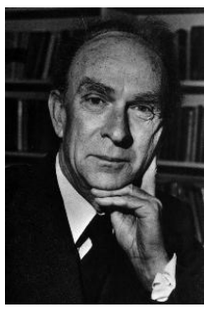
Semantic Theory: from past to present (and future?)










1900 1960 1970 1980 1990 2020 2025?

But first… the exam!

- Exam date: **Thursday July 23, 10am (sharp!)**
- Location: Conference room 1.17, Geb. C74, University Campus
- Make sure you are registered for the exam
- You can find a practice exam at:
  http://njvenhuizen.github.io/teaching/ST20/practice_exam.pdf
  As well as an example of the supplementary materials:
  http://njvenhuizen.github.io/teaching/ST20/practice_exam_suppl.pdf
- Next Thursday: Exam Q&A. Take a look at the practice exam, previous exercises, and the slides — Prepare questions!

Links

- Groningen Meaning Bank:
  http://gmb.let.rug.nl

- Parallel Meaning Bank:
  http://pmb.let.rug.nl

- Groningen Meaning Bank Web Demo:
  http://gmb.let.rug.nl/webdemo/demo.php