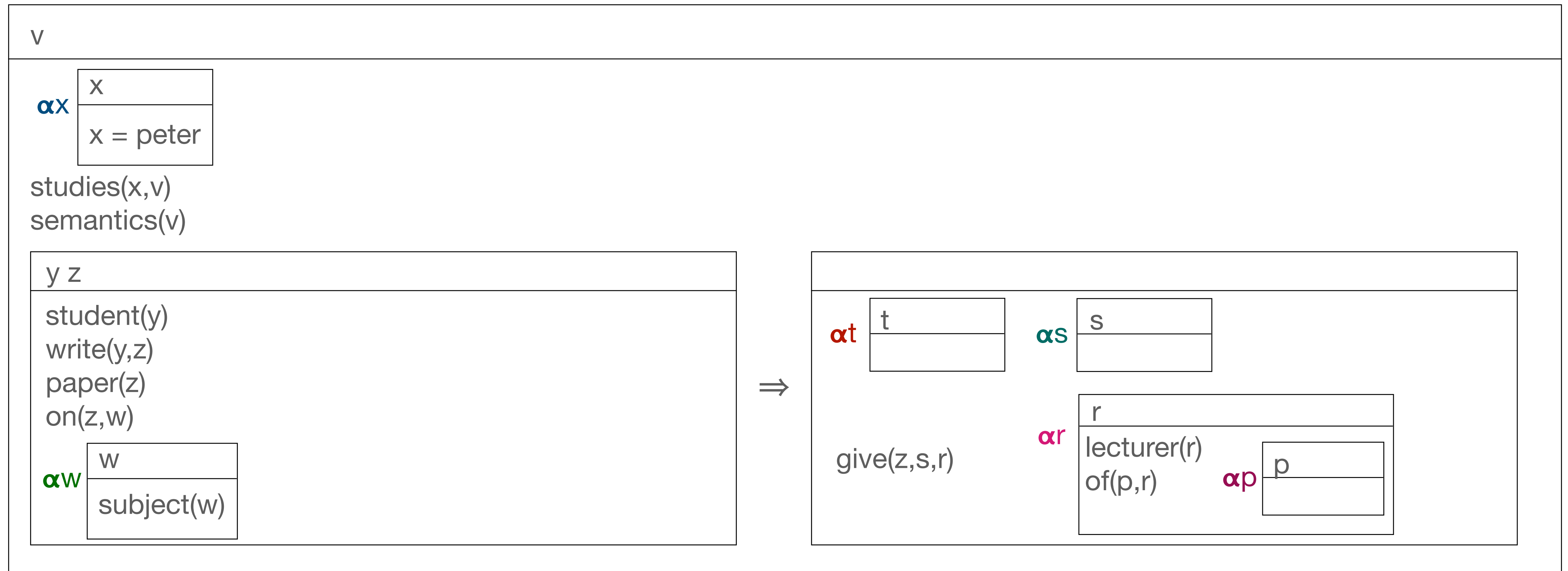


Semantic Theory

Week 12: Current Issues in Semantic Theory

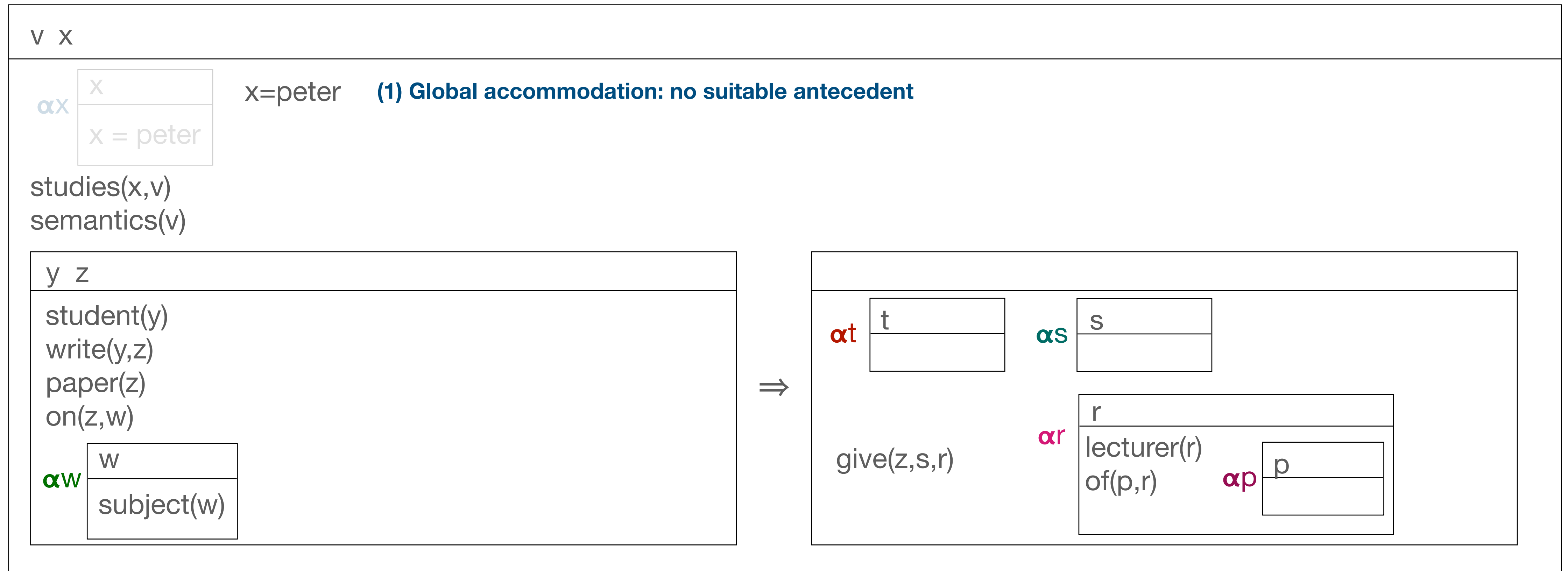
Exercise 7 - Ex. 1

- **Peter** studies semantics. If a student writes a seminar paper on **this subject**, **he** gives **it** to **his lecturer**.



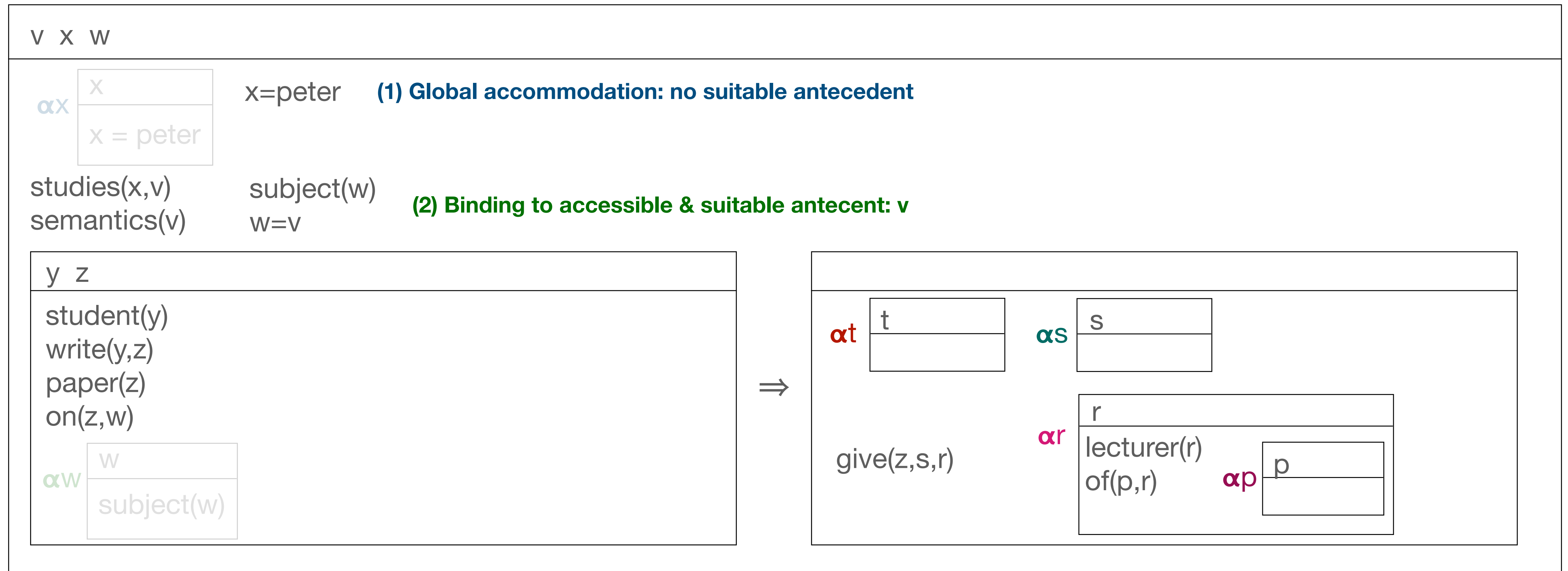
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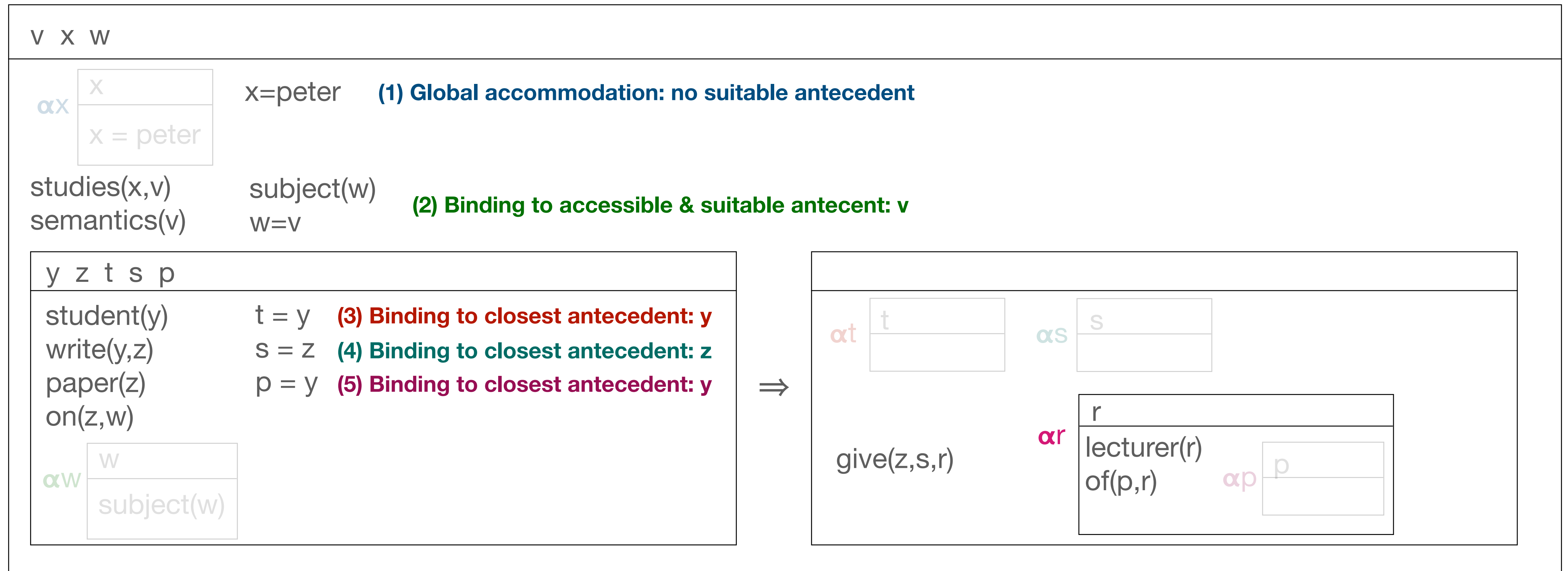
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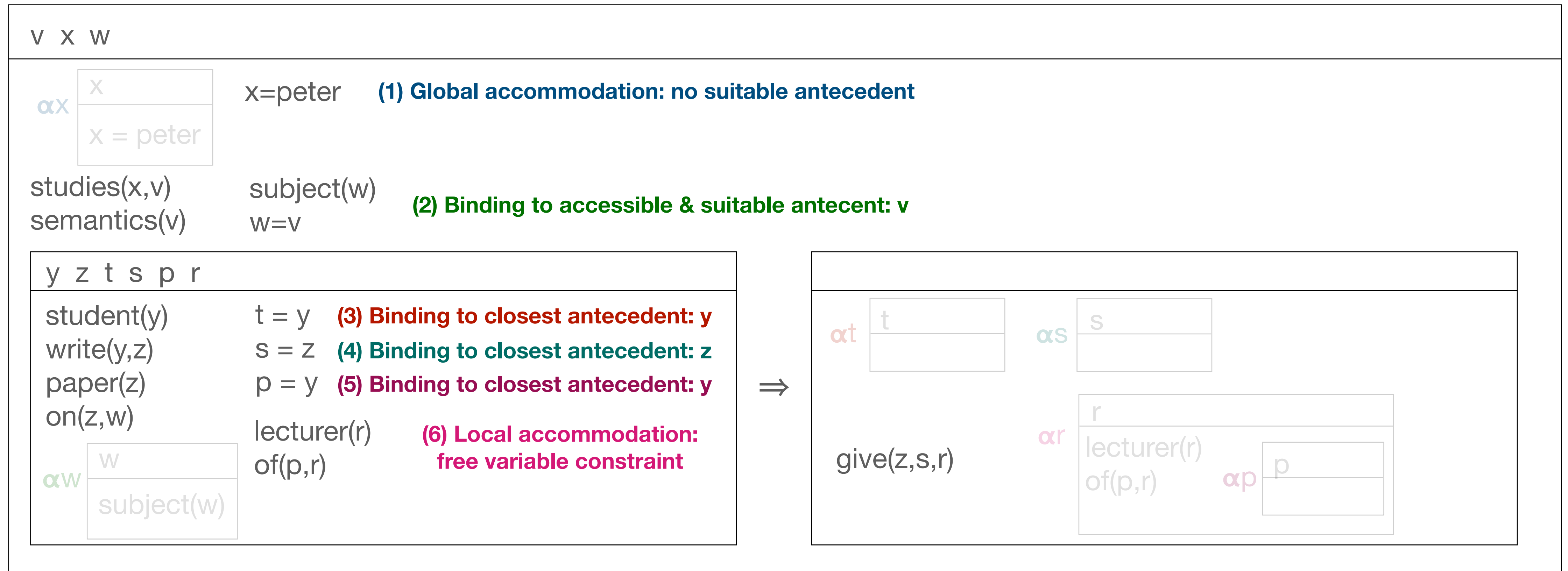
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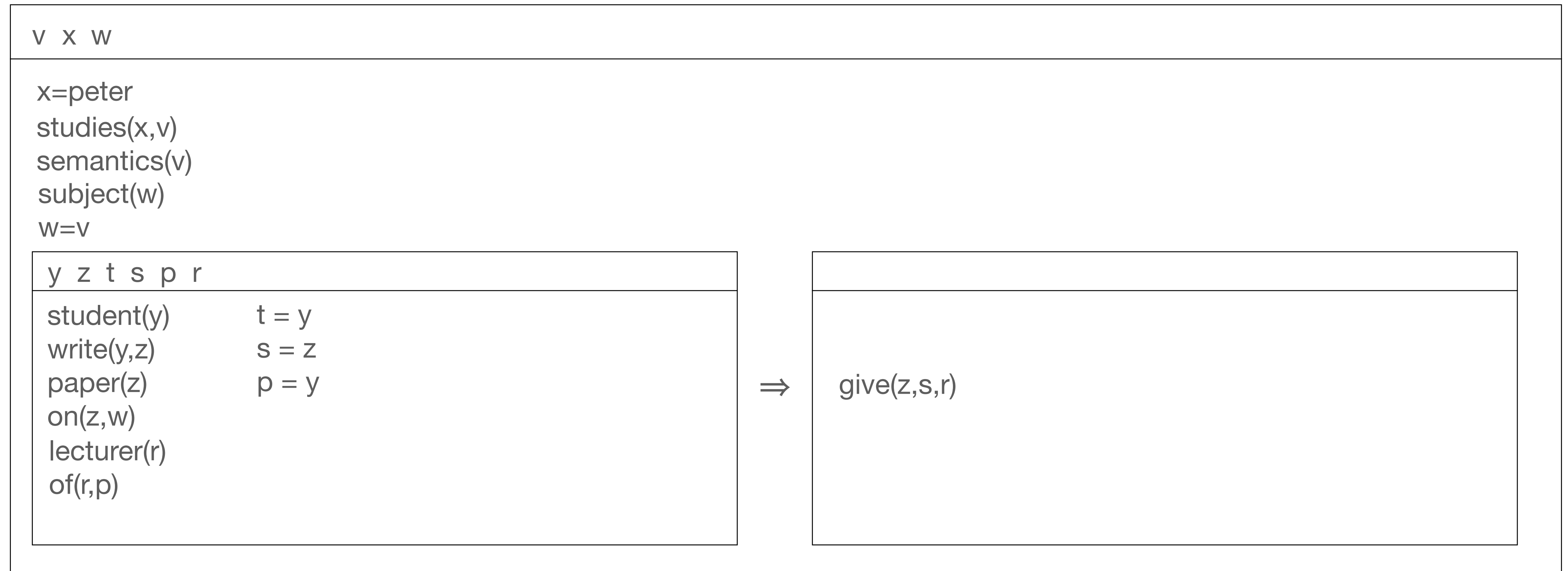
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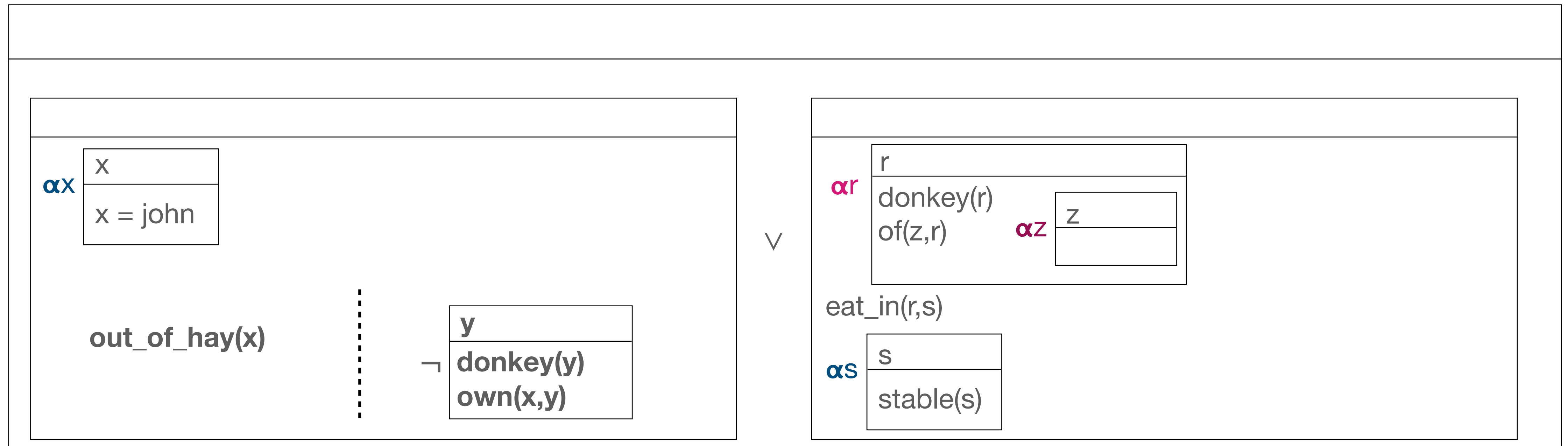
Exercise 7 - Ex. 1

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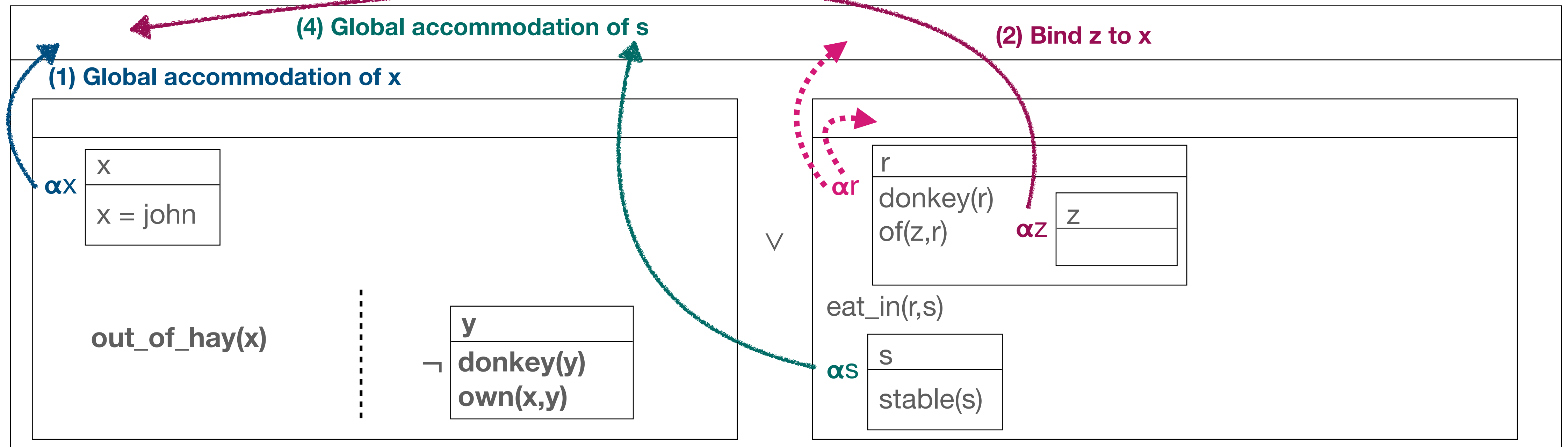
Exercise 7 - Ex. 2

- a. Either **John** is out of hay, or **his donkey** is eating quietly in **the stable**.
- b. Either **John** has no donkey, or **his donkey** is eating quietly in **the stable**.



Exercise 7 - Ex. 2

- Either **John** is out of hay, or **his donkey** is eating quietly in **the stable**.
- Either **John** has no donkey, or **his donkey** is eating quietly in **the stable**.

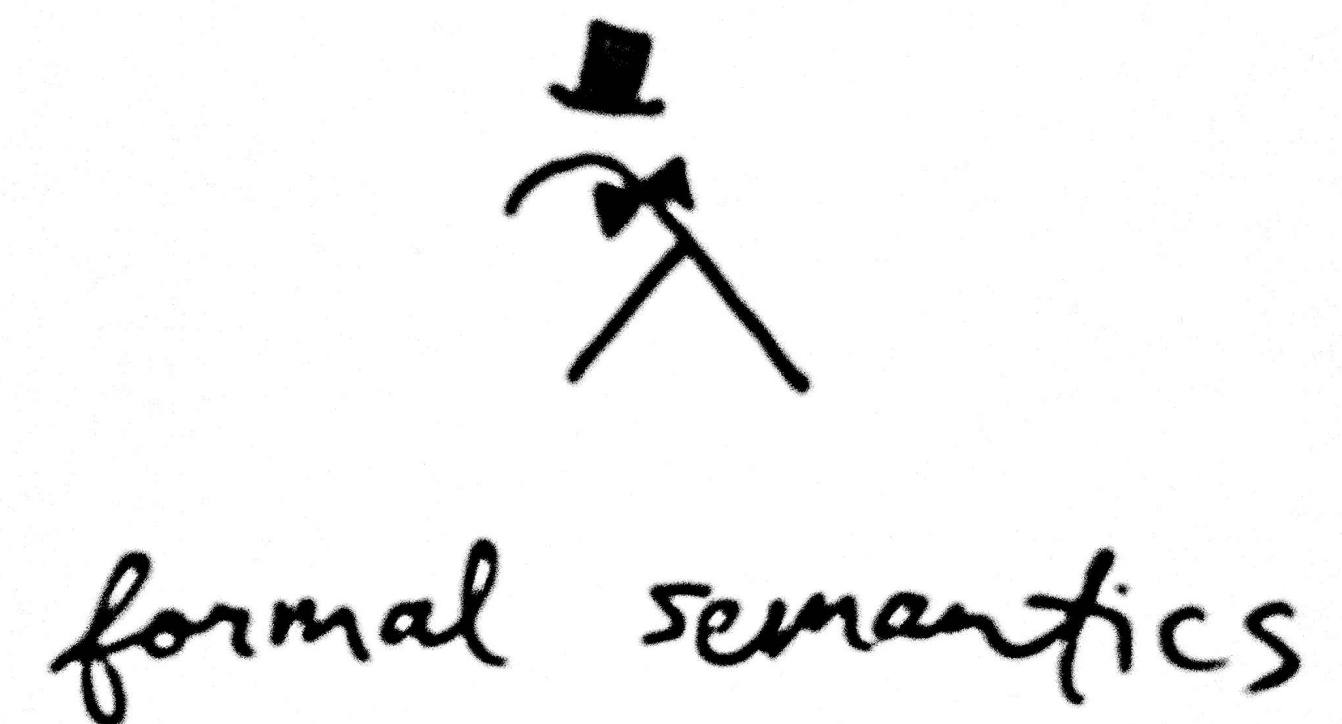


(3) Global accommodation of r vs. (3) Local accommodation of r (Local Consistency constraint)

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



© Ai Taniguchi

Open questions

Current issues in Semantic Theory

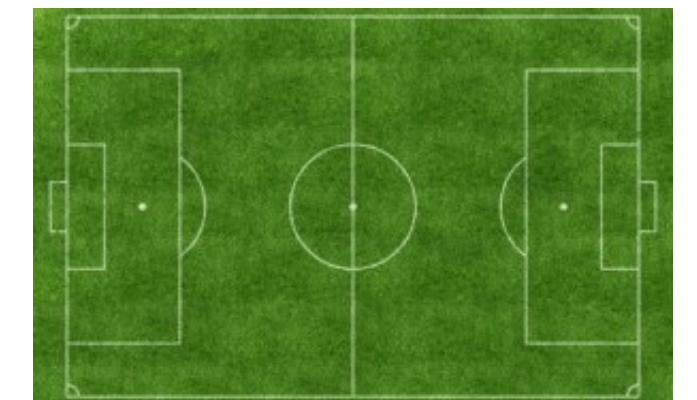
I. What is meaning?

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



II. What 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

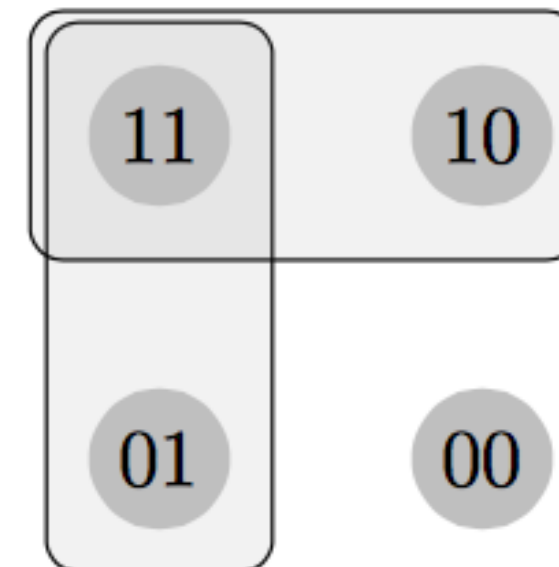


“Meaning is Information EXchange Potential”

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



(a) $\llbracket p \rrbracket$

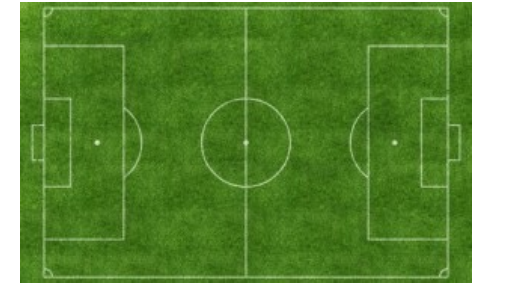


(b) $\llbracket p \vee q \rrbracket$



(c) $\llbracket ?p \rrbracket$

Defining the playing field



What can/should be captured in a semantic formalism?

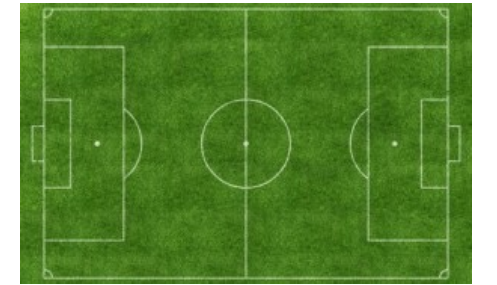
The syntax-semantics interface:

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

The semantics-pragmatics interface:

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

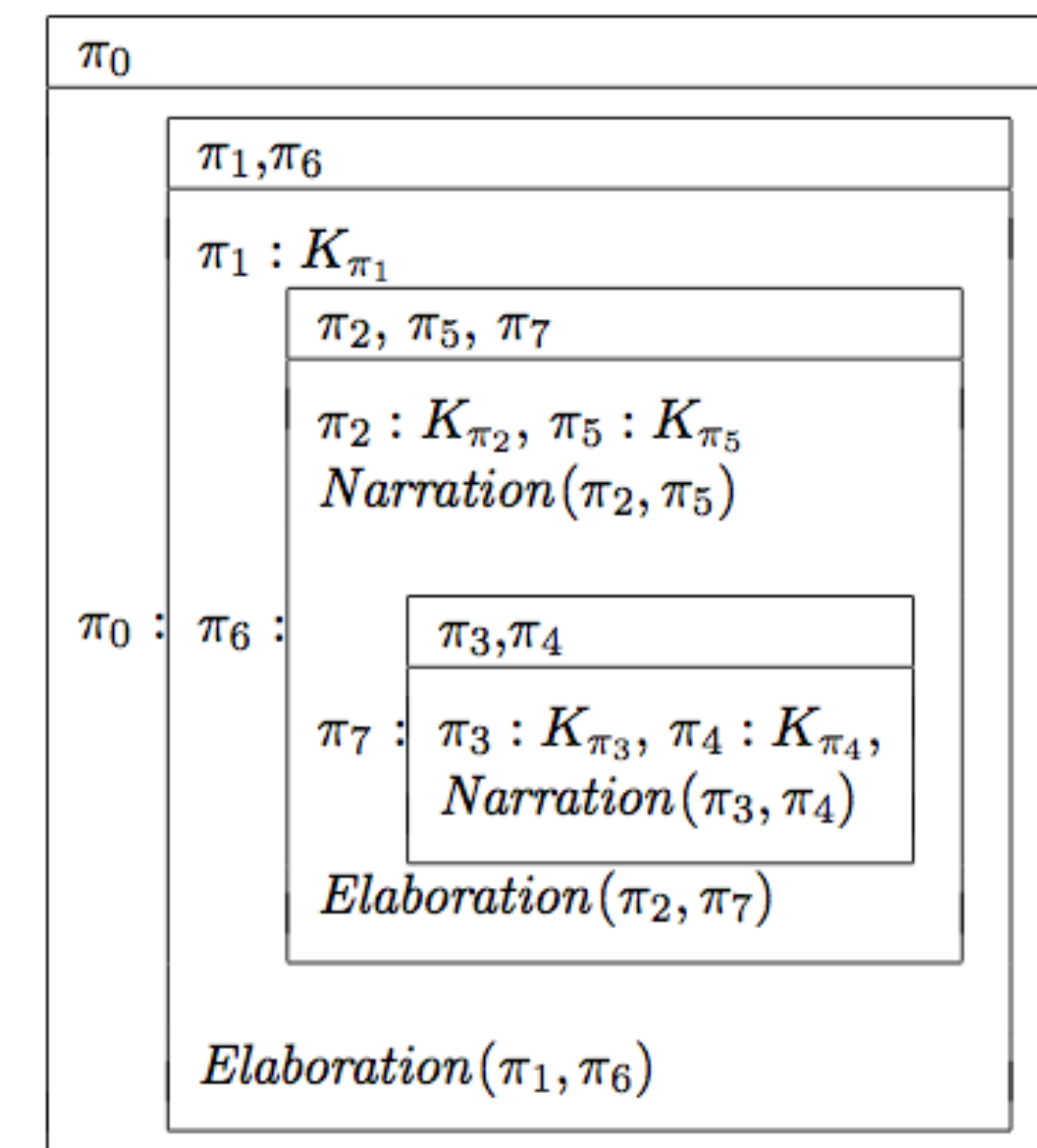
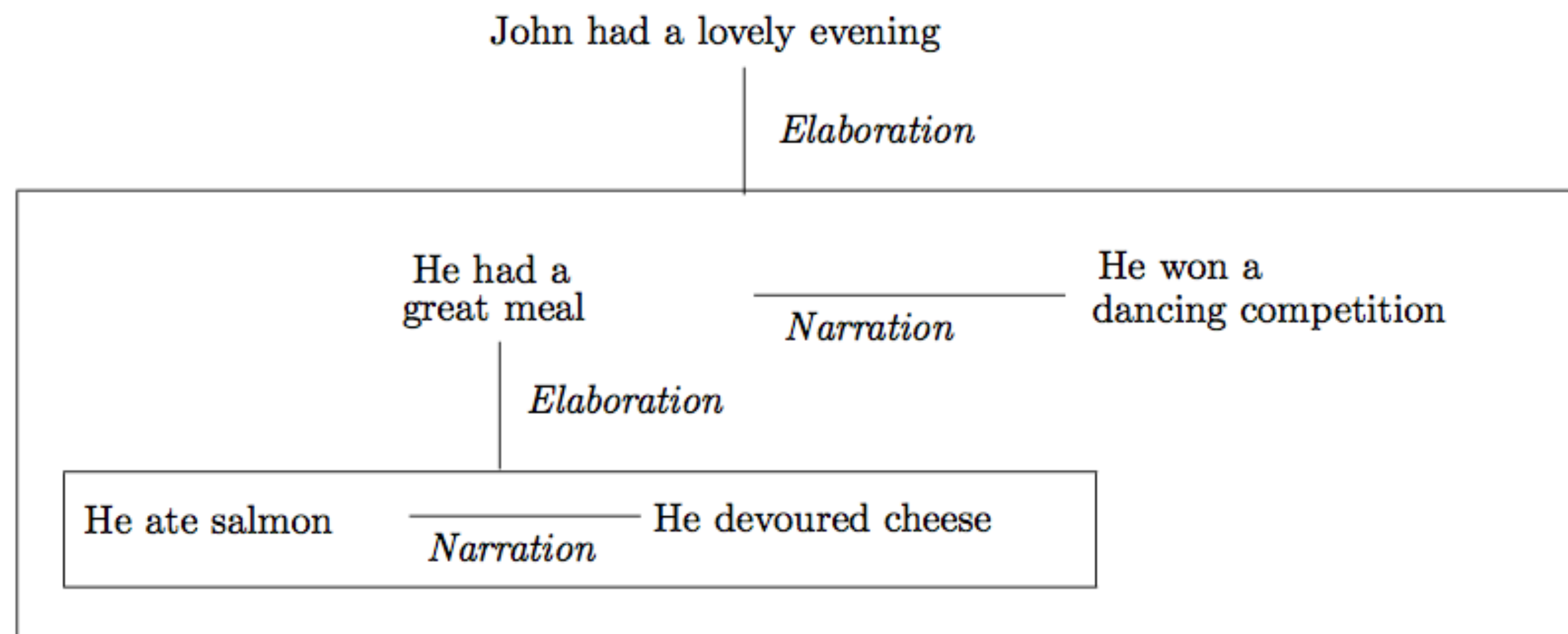
Beyond truth-conditional meaning



Rhetorical Structure

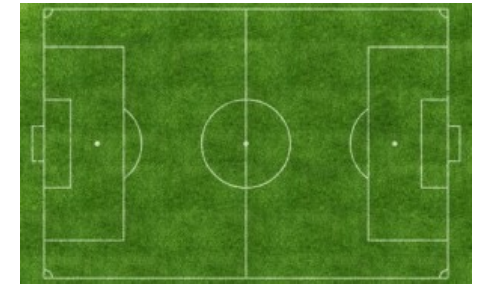
John had a great evening last night. He had a great meal. He ate salmon. He devoured lots of cheese. He won a dancing competition. ??It was a beautiful pink.

Segmented DRT: DRT with discourse relations



(Asher, 1992; Asher & Lascarides, 2003)

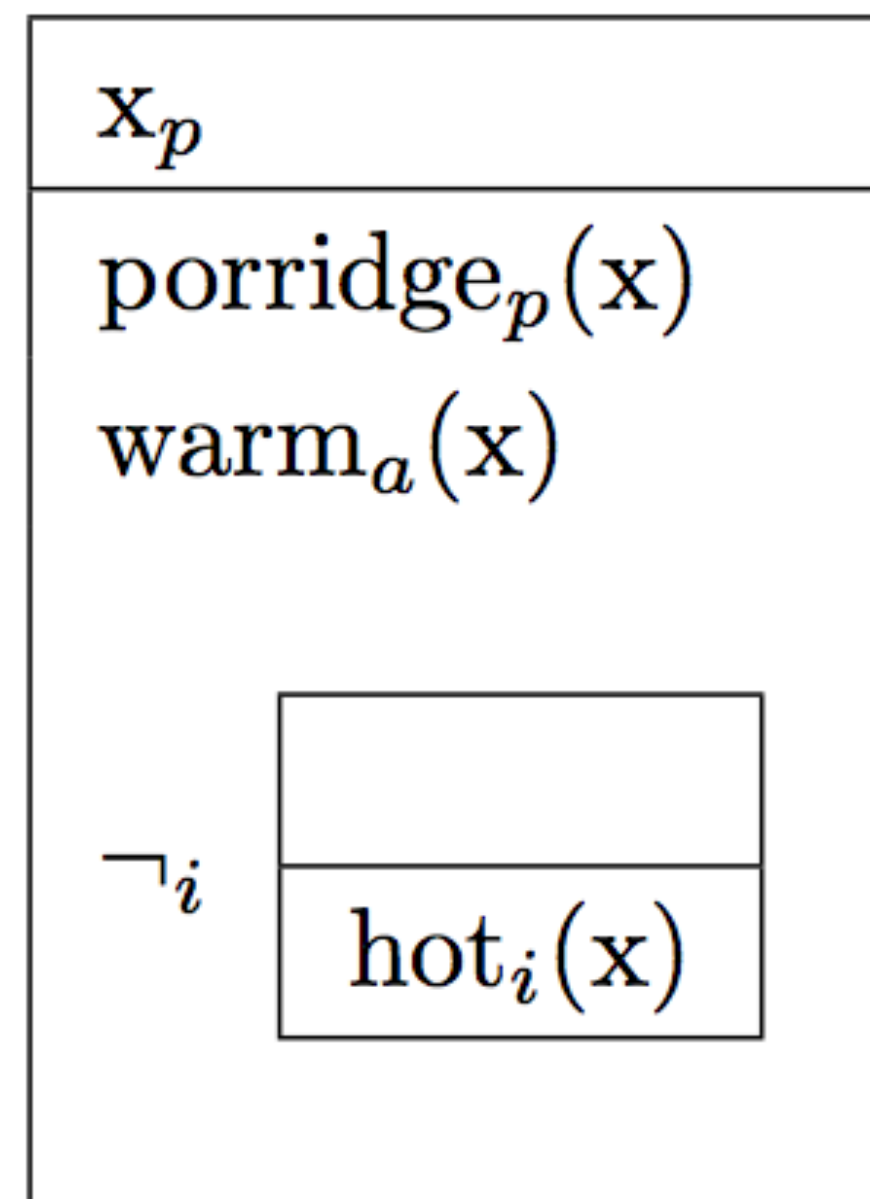
Beyond truth-conditional meaning



Implicature

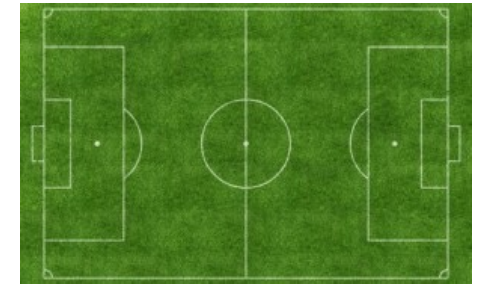
- (1) a. *The porridge is warm. As a matter of fact, it is hot.*
 b. *?The porridge is warm. As a matter of fact, it is cold.*

Layered DRT: DRT with multiple layers of meaning



Geurts & Maier 2003; 2013

Beyond truth-conditional meaning



Information structure

- (1) John 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
$2 \leftarrow x \quad 3 \leftarrow y$
$2 \leftarrow x = \text{john}$
$3 \leftarrow \text{sister}(y)$
$3 \leftarrow \text{of}(y, x)$
$1 \leftarrow \text{visit_weekly}(x, y)$
$1 \leq 2 \quad 1 < 3 \quad 3 = 2$

Formal semantics in the real world



How to apply and evaluate formal linguistic theories: **Data** \Leftrightarrow **Theory**

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

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

\Leftarrow 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

A corpus of DRSs



Groningen MEANING BANK 77/0696 Search Log in

metadata raw tokens sentences discourse 9 bits of wisdom 0 warnings

Show: pointers

```
k1 :: b1
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

k2 :: b6
b7
b6 ← p1: 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 ← 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)
b13 ← Patient(e8, x7)
b12
b11 ← x6 = x1
b12 ← x6 = x1
b13 ← e8 < t6
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
```



Distributional Formal Semantics

Neurocomputational modeling of experimental data

THE REAL WORLD

DISCOURSE PROCESSES
2019, VOL. 56, NO. 3, 229–255
<https://doi.org/10.1080/0163853X.2018.1448677>

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Expectation-based Comprehension World Knowledge and Linguistic

Noortje J. Venhuizen, Matthew W. Crocker, and

Saarland University, Saarbrücken, Germany

entropy

Article

Semantic Entropy in Language

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* Correspondence: noortjev@coli.uni-saarland.de

Received: 30 October 2019; Accepted: 25 November 2019

Abstract: Language is processed on a more or less... induced by each word is affected by our prior... about the world. Surprisal and entropy reduction theories between word processing difficulty and... are typically limited to capturing linguistic... world knowledge. A recent comprehension model (Processes) improves upon this situation by integrating linguistic experience and world knowledge... determining online expectations. Here, we extend... of entropy reduction from this model. In contrast... entropy reduction are not easily dissociated, surprisal and entropy reduction derive from... of the unfolding interpretation—they reflect... (surprisal) versus end-state confirmation (entropy reduction).

frontiers
in Psychology

ORIGINAL RESEARCH
published: 11 February 2021
doi: 10.3389/fpsyg.2021.615538

Neurobehavioral Correlates of Surprisal in Language Comprehension: A Neurocomputational Model

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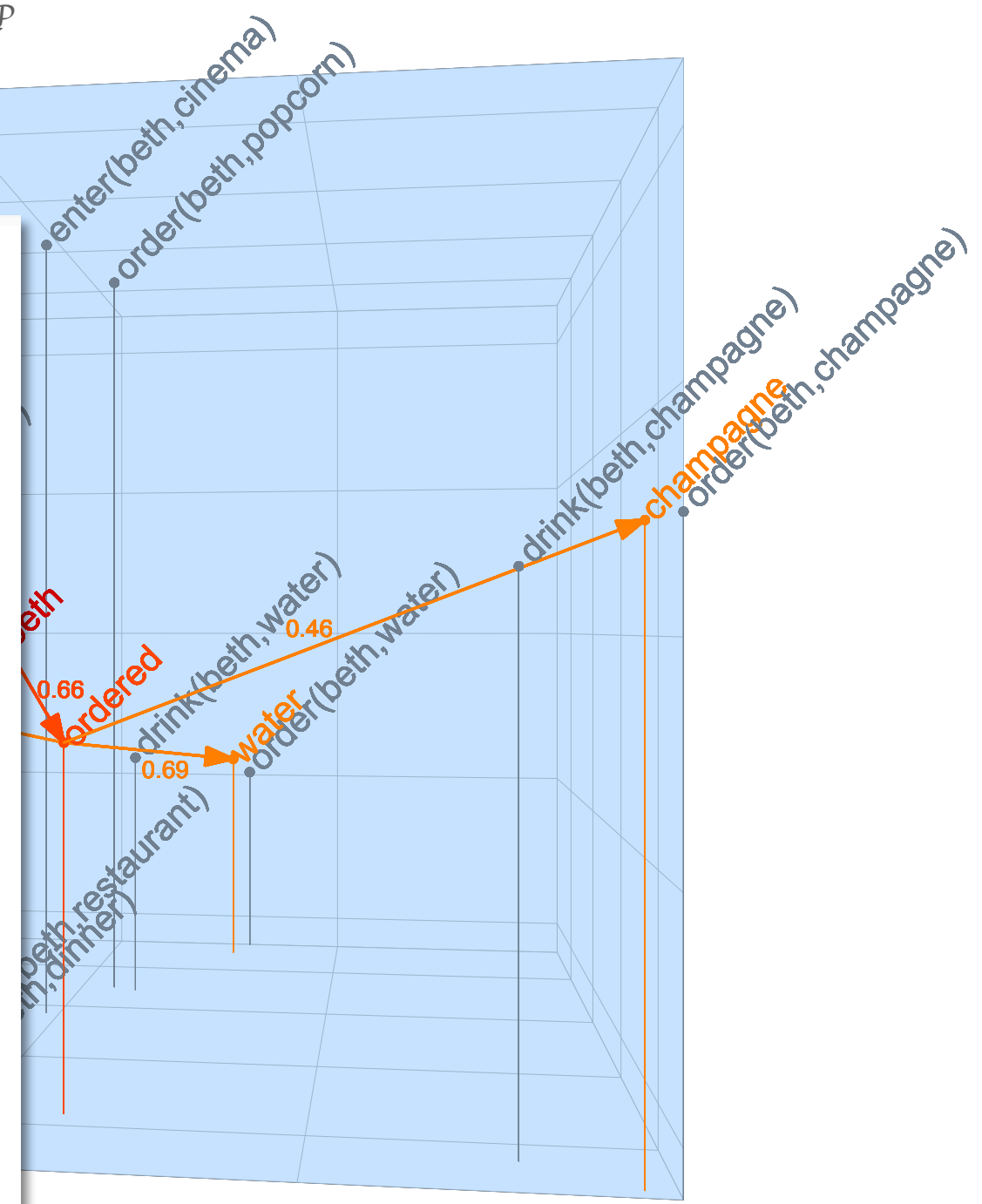
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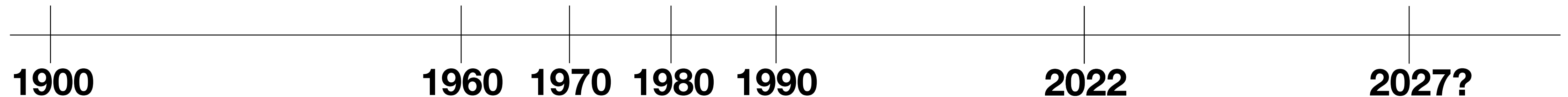
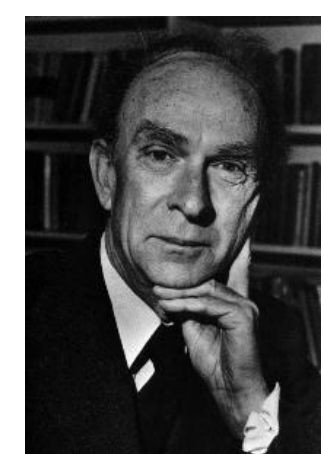
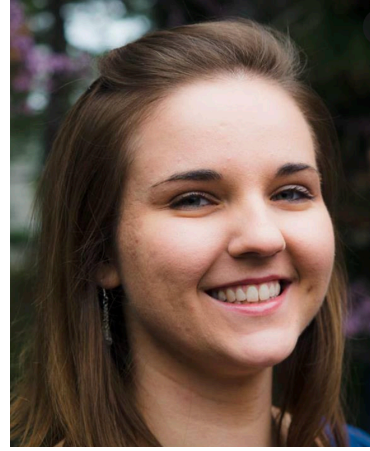
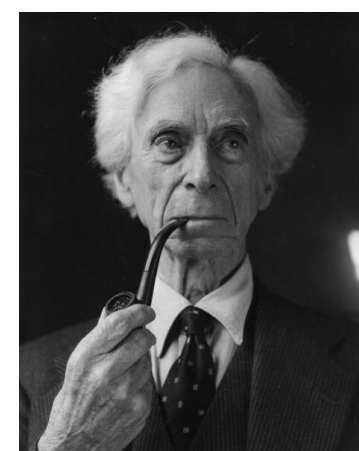
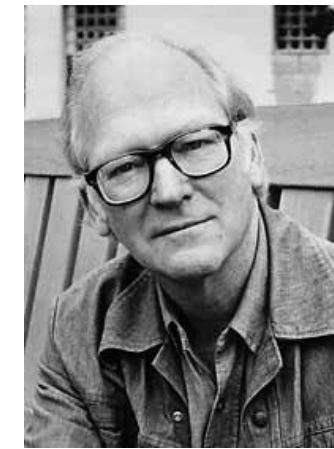
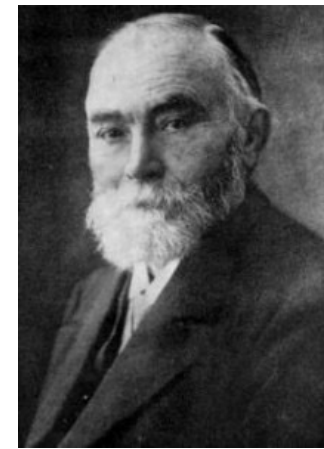
Keywords: event-related potentials (ERPs), N400, P600, language comprehension, surprisal theory

Expectation-based theories of language comprehension, in particular Surprisal Theory, go a long way in accounting for the behavioral correlates of word-by-word processing difficulty, such as reading times. An open question, however, is in which component(s) of the Event-Related brain Potential (ERP) signal Surprisal is reflected, and how these electrophysiological correlates relate to behavioral processing indices. Here, we address this question by instantiating an explicit neurocomputational model of incremental, word-by-word language comprehension that produces estimates of the N400 and the P600—the two most salient ERP components for language processing—as well as estimates of “comprehension-centric” Surprisal for each word in a sentence. We derive model predictions for a recent experimental design that directly investigates “world-knowledge”-induced Surprisal. By relating these predictions to both empirical electrophysiological and behavioral results, we establish a close link between Surprisal, as indexed by reading times, and the P600 component of the ERP signal. The resultant model thus offers an integrated neurobehavioral account of processing difficulty in language comprehension.

derive from navigating $S_{M \times P}$



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



But first.. the exam!

- Exam date: **Wednesday July 20**, 10am (sharp!)
- Location: Room -1.05 (C7.2, basement)
- Make sure you are registered for the exam
- You can find a practice exam and an example of the supplementary materials on MS Teams.
- Next **Tuesday**: **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>