ILLC-Day 2 in Bonn "Language"

June 7th, 2004

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ILLC-Day 2 in Bonn "Language" was the third installment of a series of Amsterdam-Bonn collaborative workshops, after LiB-Day in Amsterdam (June 30, 2003) and ILLC-Day in Bonn (November 30, 2003). These workshops are jointly organized by the ILLC and the collaboration **Logic in Bonn** (LiB) which is a group of logicians from four different institutes in Bonn:

`http://www.illc.uva.nl`
`http://www.lib.uni-bonn.de`
`http://staff.science.uva.nl/~bloewe/ILLC-Day2.html`

This meeting was focused on the topic of *Language* and was mainly organized by the linguists from Amsterdam and Bonn. Most of the talks were held in the *Hausdorff-Raum* of the *Mathematisches Institut* of the Rheinische Friedrich-Wilhelms-Universität (RhFWU) Bonn, except for the general audience lecture by Paul Dekker which was held in the Lecture Hall of the *Institut für Kommunikationsforschung und Phonetik*.

The workshop was financed by the *Beauftragter für die Pflege und Förderung der Beziehungen zwischen den Hochschulen des Landes Nordrhein-Westfalen, des Königreichs der Niederlande, des Königreichs Belgien und des Großherzogtums Luxemburg*, the ILLC, the NWO, and the *studium universale* of the RhFWU Bonn.

Participants. Stefan Bold, Patrick Braselmann, Lucas Champollion, Marian Counihan, Stephan Cursiefen, Paul Dekker, Bernhard Fisseni, Michael Franke, Julia Grodel, Tanja Hötte, Christian Kappler, Peter Koepke, Pjotr Labenz, Benedikt Löwe, Michael Möllerfeld, Martin Müller, Henrik Nordmark, Robert van Rooy, Hans-Christian Schmitz, Bernhard Schröder, Katrin Schulz, Oren Schwartz, Brian Semmes, Merlijn Sevenster, Jip Veldman, Charlotte Wollermann, Henk Zeevat.

Schedule.

10:00–10:30	*INFORMAL WELCOME & COFFEE*	
10:30–11:00	Katrin Schulz	Approaching the Logic of Conversational Implicatures
11:00–11:30	*COFFEE BREAK*	
11:30–12:00	Marian Counihan	Natural language in the psychology lab
12:00–14:00	*LUNCH BREAK*	
14:00–14:30	Hans-Christian Schmitz	*Stop thinking!* — Discourse particles block your mind
14:30–15:00	Bernhard Fisseni	Something empirical about focus
15:00–15:30	*COFFEE BREAK*	
15:30–16:00	Bernhard Schröder	Neuroevolutionary phenomenology of communicating agents
16:00–16:30	Pjotr Labenz	On common knowledge in conversation
16:30–17:00	*COFFEE BREAK*	
17:00–17:30	Merlijn Sevenster	Non-literal meaning and signaling games
17:30–18:00	Oren Schwartz	CVNet — on Neural Network Interpretations of OT
	Studium Universale Lecture (held at IKP)	
19:00–20:00	Paul Dekker	Questions in a Dynamic Perspective

Approaching the Logic of Conversational Implicatures

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1. Introduction

1.1 Aim of the Research

⇨ Describe the logic of conversational implicatures (Grice '57) (particularly Quantity1-implicatures)

- formally precise account
- descriptive adequate
- explanatory convincing

⇨ formalize Grice's theory of conversational implicatures

1. Introduction

1.2 Motivation

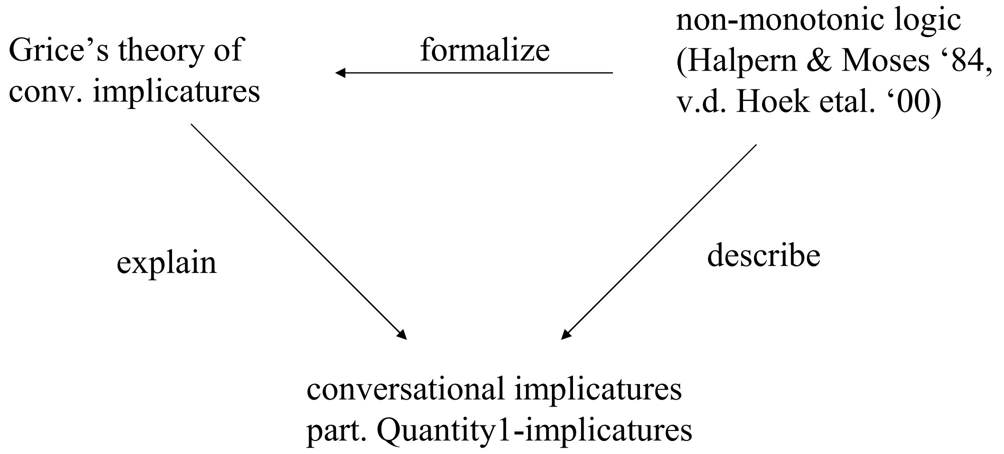
⇨ The dilemma of pragmatics:

• conversational implicatures and Grice's theory thereof have become an enormous popular ingredient of semantic theories

• there exists no precise formulation of Grice's theory that is overall convincing

1. Introduction

1.3 The Strategy



1. Introduction

1.4 The Problem

- few available data
- which are theoretical preloaded
- and inconsistent with each other

⇨ We need serious data studies! Semantics has to grow up!

1. Introduction

1.5 Outline of the talk

1. Introduction
2. The Data
3. The Proposal
4. Critical Predictions
5. Conclusion

2. The Data

Paul: Who passed the examination?
Paula: Ann or Bob passed.

- scalar implicatures: *Not both, Ann and Bob passed.*
- exhaustive interpretation: *Nobody else passed.*
- clausal implicatures: *Paula doesn't know that Ann passed.*
- context dependence:

Paul: Did Ann or Bob pass the examination?
Paula: Yes, Ann or Bob passed.

3. The Proposal

3.1 Formalizing Grice

Quantity1: The speaker makes the strongest relevant claim she can (Quality: given her knowledge)

⇨ Pragmatic interpretation function $f: L \times C \longrightarrow p(S)$

Requirements on f(A,c):

1. Speaker knows A
2. A is a *strongest* claim the speaker could have made (given her knowledge)
3. A is a strongest claim with respect to what is *relevant*

3. The Proposal

3.1 Formalizing Grice

How to formalize the requirements?

1. Speaker knows A

$$f(A,c) \models \mathbf{K}_S A$$

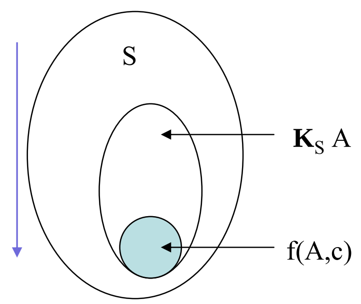
3. The Proposal

3.1 Formalizing Grice

How to formalize the requirements?

2. A is a *strongest* claim the speaker could have made (given her knowledge)

- impose an order ≤ on S
- select minimal elements with respect to ≤



3. The Proposal

3.1 Formalizing Grice

How to formalize the requirements?

3. A is maximal informative with respect to what is *relevant*

- relevant = helps to resolve the question
  → speaker knows not more about the answer than she said with A

Paul: Who passed the examination?
Paula: Ann passed. → $\neg \mathbf{K}_S P(\text{Bob})$

3. The Proposal

3.1 Formalizing Grice

Definition 1 (order):
$\forall s_1, s_2 \in S: s_1 \leq_P^1 s_2 \Leftrightarrow_{def} \forall v_2 \in R_2[w_2]\, \exists v_1 \in R_1[w_1]: P(v_1) \subseteq P(v_2)$

Definition 2 (pragmatic interpretation function):
$eps_1^S(A,P) = \{ s \in S \mid s \models \mathbf{K}_S A \;\&\; \forall s' \in S : s' \models \mathbf{K}_S A \Rightarrow s \leq_P^1 s' \}$

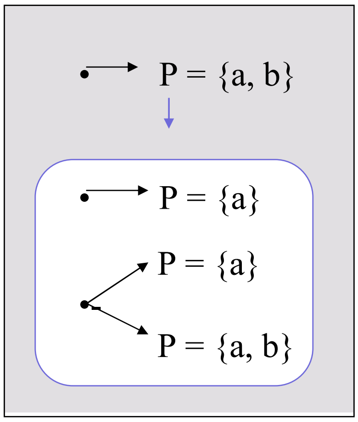
3. The Proposal

3.2 Example

Paul: Who passed the examination?
Paula: Ann passed.

$eps_1^S(P(a), P) \models \neg \mathbf{K}_S P(b)$

$\not\models \neg P(b)$



3. The Proposal

3.3 Formalizing Competence

3.3.1 The Simple Approach - does not work!

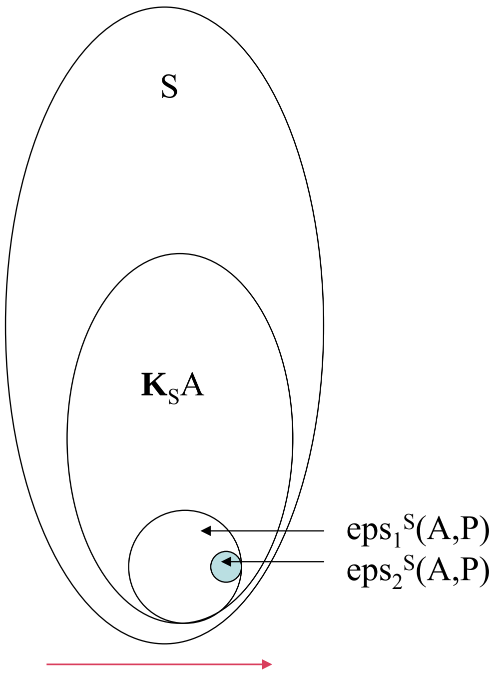
- Let $C \subseteq S$ be the worlds where the speaker is competent.
  Then $eps_1^C(A, P) \models$ scalar implicatures.

3. The Proposal

3.3 Formalizing Competence

3.3.2 Maximize Competence

- impose a second order $\leq^2$ on S
- select among those worlds in eps_1^S those worlds where the speaker is maximal competent



3. The Proposal

3.3 Formalizing Competence

Definition 2 (order):

$\forall s_1, s_2 \in S$: $s_1 \leq_P^2 s_2 \Leftrightarrow_{def} \forall v_1 \in R_1[w_1]\ \exists v_2 \in R_2[w_2]: P(v_1) \subseteq P(v_2)$

Definition 4 (pragmatic interpretation function):

$eps_2^S(A,c) = \{ s \in eps_1^S(A,c) \mid \neg\exists s' \in eps_1^S(A,c): s' <_P^2 s\}$

3. The Proposal

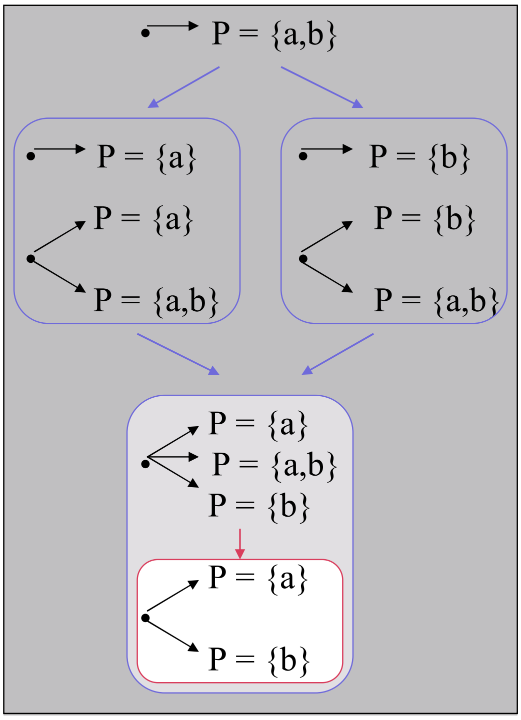
3.4 Example

Paul: Who passed the examination?
Paula: Ann or Bob passed.

$eps_2^S(P(a) \vee P(b), P)$

$\models \neg (P(a) \wedge P(b))$

$\models \neg \mathbf{K}_S \neg P(a) \wedge \neg \mathbf{K}_S \neg P(b)$



4. Critical Predictions

4.1 Context-dependence

? Do answers always come with the inferences we predict?
? Do Quantity1-implicatures occur also in other contexts
than answers to overt questions?

4. Critical Predictions

4.1 How convincing are the orders?

• The Gricean order $\leq^1$

Paul: Who passed the examination?
Paula: Ann passed. $\rightarrow \neg \mathbf{K}_S P(Bob)$
$\not\rightarrow \neg \mathbf{K}_S \neg P(Bob)$

? In the context of questions, do interpreters also infer incompetence of the speaker with respect to the complement of the question predicate?

4. Critical Predictions

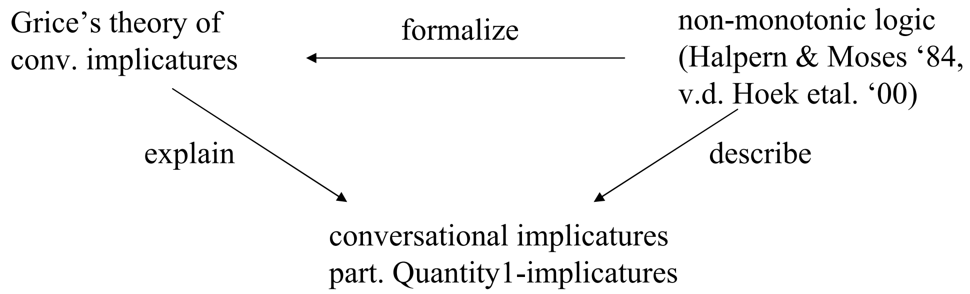
4.3 The Functionality Problem

Paul: Who passed the examination?
Paula: (i) Not Ann.
(ii) If he did not oversleep Bob passed.
(iii) Maybe Ann passed.
…

? What form-aspects are relevant for Quantity1-implicatures?
? Can we give a Gricean-like motivation for such form restrictions?

5. Conclusions

5.1 The Approach



• two pragmatic interpretation functions

1. eps_1^S → formalizes inferences due to Quantity1 and Quality
2. eps_2^S → formalizes maximizing competence

5. Conclusions

5.1 Achievements

• formally precise approach to conversational implicatures; hence, strong in its predictions
• unified account to Quantity1-implicatures
• based on the well-known and well-established ideas of Grice

5.2 Open Questions

• test the descriptive adequacy of the approach
• the role of competence in natural language interpretation
• extension to other conversational implicatures

Tales of the Unexpected:

language and cognitive access in the psychology laboratory

Marian Counihan
Logic and Cognition group
ILLC, University of Amsterdam

Questions, comments? Please contact me at
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Background to this talk:

- my work is concerned with finding out how people reason
- in psychology of reasoning this has been tackled with prescribed experimental paradigms
- and a quantitative approach to data collection
- my tack: this is an inadequate approach to cognitive processing
- in particular, this is because we need to pay attention to the **construction of meaning** in the lab

Plan of the talk:

- discuss cases where meaning plays a role in experimental tasks
- discuss why and how to take meaning into account

Language matters in accessing cognition

Language-for-the-task:

- access ability *via* linguistic means **vs.** ability = linguistic means
- e.g. false belief task - explaining the failure of young children and deaf adolescents.

Discourse genres:

- cross-cultural work indicates that participating in the discourse of psychological task requires prior inculturation in school environment - learning to be a 'universal' subject?
- social-psychological strangeness of some tasks - mix of co-operative and critical stance required

Language mismatches:

- natural language connectives $\neq$ those of the propositional calculus
- comes to the fore in logical reasoning tasks - syllogistic, selection task

False belief task

Method: Child sees familiar container - say a Smarties box. They are asked what they think is inside. Box is then opened to reveal unexpected contents, e.g. a plastic frog. Child is again asked what they thought was in the box (before they saw the frog). Also often asked what their friend in the next room will think is in the box.

Crucial 'false belief' question:

what did you think was in the box?

- normally developing children > 4 years old: 'Smarties'
- children < 4 years old: 'a plastic frog'
- autistic children (and adults): 'a plastic frog'
- deaf children < adolescence: 'a plastic frog'

What comes first - language or thought?

- **Cognition scaffolds language**: standard account in terms of concept acquisition/cognitive capacity (Perner, Leslie). The correct response requires a report of previous false belief; subjects can only do this if they can and have acquired the concept of belief.

- **Cognition separate from language**: task is a test of linguistic competence, and there is evidence of working knowledge of false belief much earlier - in deception and pretend play (Chandler).

- **Language scaffolds cognition**: deaf children perform badly even on non-verbal versions of the test, and have delayed development in language but not socialisation. This suggests that specific syntactic structures are required, to make 'representational capacity' for propositional attitude reports available (de Villiers).

Discourse genres

- Studies with illiterate subjects (Luria, Scribner) suggest that reasoning on basis of given premises is not something done 'naturally' but must be learnt.
- Is education teaching us how to think? Does the charge of the 'pre-logicality' of traditional societies stick?
- No: work with preschool children (Harris & Leevers) , and examination of transcripts from illiterate subjects indicates this is not the case.
- What is learnt is not the skill (logical reasoning) but rather appropriate contexts of use of the skill; discourse contexts which cue roles.
- But they are not always mastered: 'belief bias' effects in syllogistic reasoning indicates subjects still take own beliefs into account.
- Even when the genre of the task and the role of participant are understood, more subtle problems can arise.

Language mismatches: ... or the projection of theory onto nature

- natural language connectives $\neq$ those of the propositional calculus
- the success of classical logic has been counterproductive here, since it gives the idea that the conditional is understood, and that its essence is captured by the material implication.
- comes to the fore in logical reasoning tasks - syllogistic, selection task
- but surely *some* connectives - like the conjunction - are simple?

Classical logic has been immensely successful. But this very success has enshrined certain formats and procedures, that also have drawbacks. For instance, many themes suffer from what may be called 'system imprisonment'. We have to discuss the behaviour of [say] negation inside specific formal systems, such as propositional or predicate logic - even though these systems do not correspond to meaningful distinctions in the 'open space' of actual reasoning.

van Benthem (2000)

Conjunctive version of the Wason selection task

Conditionals are known to be complex. In contrast, the conjunction is much simpler. If we replace the conditional with a conjunction, does it reduce the task complexity and lead to more 'logical' answers?

There are As on one side of the cards and 4s on the other.

Formulate as conjunction $p \wedge q$, then results were as follows:

- **none**: 5 / 4(3)
- all: 0 / 2
- p, q: 3 / 1
- $p, \neg q$: 0 / 2
- p: 1 / 0
- $\neg p, \neg q$: 1 / 1(0)

The conjunction as existential

(or the universally quantified conjunction
as a conjunction of existentials)

[subject 8 in the conjunctive condition; ticked no cards in the written]

S: *OK. Um I wasn't sure exactly what that was all about. ...* **I think that's already true, cause there's an A there (pointing at the A) and there's a 4 there** *(now at the 4), so I guess that's already proven, just by looking at it.*

E: *OK. So you don't need to turn any of the cards?*

S: *No, but I think I probably ticked that I did. Cause it's quite confusing.*

Notice that this subject makes the competent choice - for very different reasons than presumed. Clear evidence that ticking boxes is not enough!

The conjunction as disjunction
(or the free choice paradox in reverse)

[subject 7 in the conjunctive task; ticked A in written task; has just done original task correctly]

S: *OK. Well this is basically saying that ... so this means that there's going to be at least an A or a 4 on each card.*

E: *What, this rule?*

S: **This rule says that there's going to be either an A or a 4.** *So which would mean there'd be a 4 here (pointing to the K) and a A (on the 7) here.*

The conjunction as conditional
(or the conditional is only easy when disguised)

[subject 1; chose A,4 in conditional condition; ticked no cards in the written; chooses A and 7]

E: *So that combination, the K and the 4, doesn't disprove the rule - is that what you are saying?*

S: *Yes, because it doesn't say, that, (pause) erm, any even number on one side has to have a vowel on the other. ...* **It just says if there's a vowel there's got to be an even number on the other side**.

[subject 5; ticked A,4 in the written]

S: *Exactly the same, I'd turn these two (the A and 4), 'cause there are As on one side and 4s on the other.* **It's the same statement, just written in a different way. Isn't it? Because they've missed out the 'if', that's all, that's all they've missed out.**

Thus far ...

- Subjects' grasp of language and discourse play a role in their responses on cognitive tasks - what that role is, differs from task to task
- Role is crucial in the case of logical reasoning tasks, but has largely been ignored in task set-up (e.g. response possibilities) and in theorising.
- Logical form is a function of semantic meaning, not just syntax
- ... and meaning is a function of discourses, not just sentences

in sum: **we need to take meaning into account**

... so why hasn't this happened yet?

Why have aspects of meaning been neglected?

- access is indirect at best, impossible at worst
- lack of cross-disciplinary research
- cognitive psychology wants to be an objective science
- 'lab situation' in the physical sciences: **control of stimuli**
  - what happens when subject of investigation is human and stimuli is linguistic? does it matter?
  - depends on nature of task: does subject have to operate on internal representation or just report it?
  - perception tasks vs higher-level cognitive tasks - cf 'illusions' in both cases
- slows research and changes its focus

Bruner's diagnosis: the computational metaphor

Very early on [in the cognitive revolution], ... emphasis began shifting from "meaning" to "information", from the *construction* of meaning to the *processing* of information. The key factor in the shift was the introduction of computation as the ruling metaphor and of computability as a necessary criterion of a good theoretical model. Information is indifferent with respect to meaning.

Bruner, *Acts of Meaning* (1990)

A revealing quote from Wason

One of the curious things about the earlier, introspective studies of thinking was that they demonstrated more than anything the inadequacies of their own methods. The course of thinking is affected by factors which are not available to introspection. Modern experimental work has avoided some of the issues by restricting itself to studying what people do when they solve problems.

Wason, *Reasoning* (1966)

Redressing neglect of meaning

- take a more exploratory approach
- get more information from each subject - within and across tasks
- look to other disciplines for help

but what does this buy you?

Wason's selection task

Below is depicted a set of four cards, of which you can see only the exposed face but not the hidden back. On each card, there is a number on one of its sides and a letter on the other.
Also below there is a rule which applies only to the four cards. Your task is to decide which if any of these four cards you *must* turn in order to decide if the rule is true. Don't turn unnecessary cards. Tick the cards you want to turn.
Rule: *If there is an A on one side, then there is a 4 on the other side.*

Cards:

A	K	4	7

Typical results

Formulate

If there is an A on one side, then there is a 4 on the other side.

as an implication $p \rightarrow q$, then the observed pattern of results is typically given as follows:

- 0–5% $p, \neg q$
- 45% p, q
- 35% p
- 7% $p, q, \neg q$
- rest miscellaneous

Logically correct answer in this case should be $p, \neg q$

An explanation of the modal choice 'A, 4'

- conditionals with true consequents are odd, maybe even ungrammatical e.g. *'If polar bears are difficult to hunt, then polar bears are white'*
- Fillenbaum (1978) observed subjects doing **pragmatic normalisation** - changing features of the original sentence to make more sense of it: *'Clean up or I won't report you'* becomes *'If you don't clean up, I'll report you*
- does normalisation occur in the Wason task?
- decompose conditional into
  If there's an A on the face, then there's a 4 on the back, **and**
  if there's a A on the back, there's an 4 on the face.
- and normalise to:
  If there's an A on the face, then there's a 4 on the back, **and**
  if there's a 4 on the face, there's an A on the back.
- A, 4 is the competent choice on this assumption
- explains judgement of K-4 as irrelevant, 4-K as falsifying

Interim conclusions

- Construction of meaning is integral to cognitive processing
- Reasoning processes operate on this constructed meaning
- Known aspects of conditional meaning can be recruited to explain data
- Discourse setting also needs to be taken into account
- Leading to better experimental set-ups
- Resulting in a richer and more plausible theory of human reasoning

Stop thinking! Discourse particles block your mind

Hans-Christian Schmitz

ILLC-Day 2: Language
Bonn 2004

1. "Eigentlich" in update semantics
2. Cooperative communication and semantic enrichment
3. Avoiding semantic enrichment
4. Outlook

“Eigentlich” in update semantics

Disagreement on the meaning of “eigentlich”:

- “Eigentlich” marks the most relevant, very important, essential. (*strictly speaking*)
- “Eigentlich” marks the not so relevant, less important. It makes an utterance casual, even half-hearted. (*actually, by the way*)

Hypothesis: “Eigentlich” does not change the truth-conditions of a sentence but is used to block default conclusions that might otherwise be drawn by the hearer.

(1) **A:** We want to go swimming. Will you come with us?

B: Ich muss meinen Artikel fertig schreiben.
(I have to finish my paper.)

B’: Eigentlich muss ich meinen Artikel fertig schreiben.
(Eigentlich, I have to finish my paper.)

Default rule: If someone has to finish a paper, then he normally will not go swimming. ($p \rightsquigarrow q$)

(2) **1** If it is raining, the temperature is normally below 15°C.
$(p \rightsquigarrow r)$

2 If there happens to be an easterly wind, the temperature is normally 15°C or higher.
$(q \rightsquigarrow \neg r)$

3 It is raining. (p)

4 There happens to be an easterly wind. (q)

5 It is raining, and there happens to be an easterly wind. $(p \wedge q)$

6 Eigentlich regnet es. $(eigentlich(p))$
(Eigentlich, it is raining.)

7 Eigentlich regnet es, aber der Wind weht von Osten.
$(eigentlich(p) \wedge q)$
(Eigentlich, it is raining, but there happens to be an easterly wind.)

8 Eigentlich weht der Wind von Osten. $(eigentlich(q))$
(Eigentlich, there happens to be an easterly wind.)

9 Eigentlich weht der Wind von Osten, aber es regnet.
$(eigentlich(q) \wedge p)$
(Eigentlich, there happens to be an easterly wind, but it is raining.)

For any proposition p, $eigentlich(p)$ entails p.

$Eigentlich(p)$ does not change the knowledge of some default rule $p \leadsto q$.

The sentences p and $eigentlich(p)$ are true under the same circumstances, i.e. they have the same propositional meaning. But $eigentlich(p)$ and p differ in their information update potential. An update with $eigentlich(p)$ blocks defaults from applying in the resulting information state. It avoids semantic conclusions to be drawn by the hearer.

The effects of "eigentlich" vs the effects of "aber":

(3) Eigentlich regnet es, aber der Wind weht von Osten.
(Eigentlich, it is raining, but there happens to be an easterly wind.)

(4) Eigentlich weht der Wind von Osten, aber es regnet.
(Eigentlich, there happens to be an easterly wind, but it is raining.)

(5) Es regnet, aber der Wind weht von Osten.
(It is raining, but there happens to be an easterly wind.)

(6) Der Wind weht von Osten, aber es regnet.
(There happens to be an easterly wind, but it is raining.)

(7) Eigentlich regnet es, aber der Wind weht von Osten.
(Eigentlich, it is raining, but there happens to be an easterly wind.)

(8) Es regnet, aber der Wind weht von Osten.
(It is raining, but there happens to be an easterly wind.)

(9) Es regnet, aber eigentlich weht der Wind von Osten.
(It is raining, but eigentlich there happens to be an easterly wind.)

(10) Eigentlich regnet es. – Es regnet.
(Eigentlich, it is raining. – It is raining.)

Cooperative communication and semantic enrichment

(11) It is raining. $\rightrightarrows_{se}$ It is raining here, in Amsterdam, ...

(12) Entrance. $\rightrightarrows_{se}$ This door is the entrance to ...

(13) Who came to the party? — John.
$\rightrightarrows_{se}$ (Only) John came to the party.

(14) Will you come to the party? — I have to finish my paper.
$\rightrightarrows_{se}$ No, I will not come to the party.

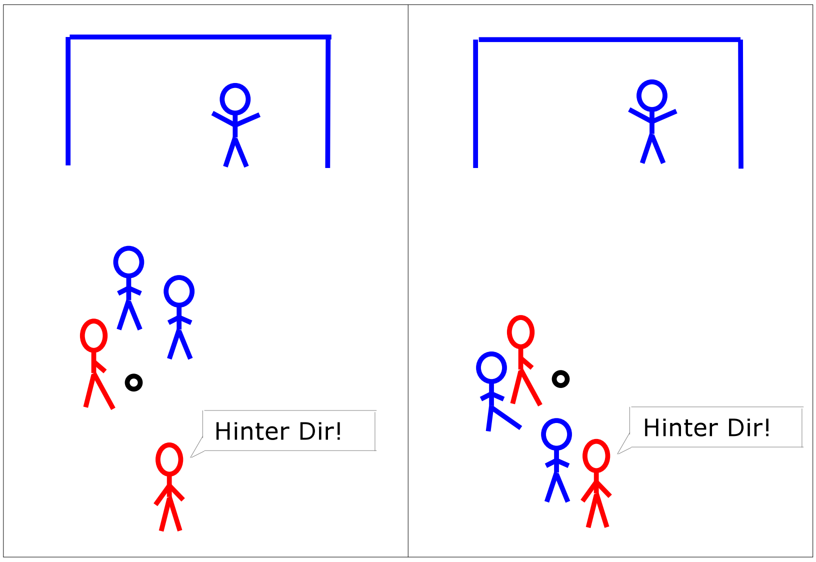


Figure 1: football, cooperative utterance

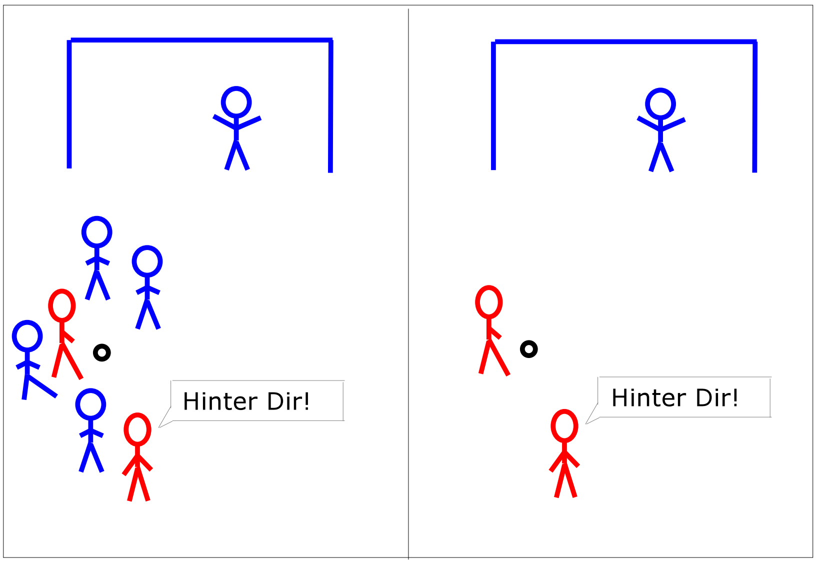


Figure 2: football, not so cooperative utterance

(15) What time is it? —It is 18:03h, but my watch is 3 minutes fast.
(Wie spät ist es? —Es ist 18:03h, aber meine Uhr geht 3 Minuten vor.)

Experiment – 33 TPs (22 NSs, 11 NNSs) –:

- 31 TPs (94%): It's 18:00h.
- 2 TPs (6%): It's 18:03h.

(16) Which day of the week is it? —It's wednesday, but my calendar is for the year 2002.
(Welcher Wochentag ist heute? —Es ist Mittwoch, aber mein Kalender ist von 2002.)

Experiment – 33 TPs (22 NSs, 11 NNSs) –:

- 14 TPs (42,4%): It's wednesday.
- 9 TPs (27,3%): It's friday.
- 3 TPs (9,1%): It's some other day of the week
- 7 TPs (21,2%): I don't know.

$$0[p \rightsquigarrow q][?q][p] \models presumably(q)$$

$$0[p \rightsquigarrow q][?q][p] \rightrightarrows_{se} q$$

$$0[?P(x)][P(a)] \models P(a)$$

$$0[?P(x)][P(a)] \rightrightarrows_{se} \forall x[P(x) \leftrightarrow x = a]$$

repr-cg(σ_s)

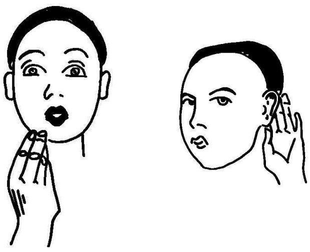
message(ϕ)

utter($A_1 \oplus \ldots \oplus A_n$, σ_s, ϕ)

adequate$_1$(ϕ, σ_s)

adequate$_2$($A_1 \oplus \ldots \oplus A_n$, σ_s)

update(σ_s, ϕ, σ_s^{new})



repr-cg(σ_r)

accommodate(σ_r, σ'_r)

reconstruct($A_i \oplus \ldots \oplus A_j$, σ'_r, ϕ')

adequate$_1$(ϕ', σ'_r)

adequate$_{2'}$($A_i \oplus \ldots \oplus A_j$, σ'_r)

update(σ'_r, ϕ', σ_r^{new})

The speaker sends a message ϕ by uttering the sequence of words $A_1 \oplus \ldots \oplus A_N$.
The recipient recognizes $A_i \oplus \ldots \oplus A_j$ and reconstructs the message ϕ'.

Avoiding semantic enrichment

$$0[p \rightsquigarrow q][?q][eigentlich(p)] \models presumably(q)$$

$$0[p \rightsquigarrow q][?q][eigentlich(p)] \not\approx_{se} q$$

(17) Will you come to the party? — *Eigentlich*, I have to finish my paper.

(18) Who came to the party? —John.

(19) Who came to the party? —Only John.

(20) Who came to the party? —At least John.

Outlook

Particles in Hintikka-style language games:

(21) I just took the money.
(Ich habe das Geld halt genommen.)

(22) Warum hast du das Geld genommen? – Habe ich halt.

Experiments:

(23) Wie spät ist es? – Es ist eigentlich 18:03h, aber meine Uhr geht 3 Minuten vor.
(What time is it? – *Eigentlich*, it is 18:03h, but my watch is 3 minutes fast.)

Something Empirical about Focus

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Second ILLC day in Bonn
7th June 2004

Contents

1. Foci

A little discouragement

> The category focus is notoriously obscure.
>
> von Stechow (1991)

1.1. Motivation

(1)	**Frank** is reading a book.	*Who is reading [a book]?*
(2)	Frank is reading a **book**.	*What is Frank reading?*
(3)	Frank is **reading** a book.	*What does Frank do with a book?*

Does Frank still use his books to support his furniture?

Observation: What answers a question is specially accentuated.

1.2. Kinds of Foci

Phonetic Foci are specially accentuated.

(Morpho-)Syntactic Foci must be placed somewhere in a sentence.

Semantic Foci are special constituents of sentences which associate with certain operators and contribute to the denotation of an expression.

Pragmatic Foci can be modelled as answers to background questions and give rise to context-dependent conclusions (implicatures). Usually they are new in the discourse or for at least one discourse participant.

1.3. Overview of the Terminology

ψ Subjekt	ψ Prädikat		(H. Paul)
Theme	Rheme		(Daneš)
Topic	Comment		(z.B. Reinhart (1982))
Topic proper	Topic[Rest]	Focus	(Prague School, Hajičová)
Ground		Focus	(formal Semantics)
Link	Tail	Focus	(Vallduví)
Ground		Focus	(formal Semantics)
Background	Focus-Phrase	Focus	(late Krifka)

1.4. Syntax: Where to put a focus

(Vallduví, Hajičová, É. Kiss).

(4) a. Trueman **è morto**.
b. È morto **Johnson**.

1.5. Semantics: Association

1.5.1. Examples

(5) Frank only **reads** books on focī.

(6) Frank only reads **books** on focī.

(7) Frank only reads books on **focī**.

We should of course not focus solely on *only* alone but always also look at even other focus operators.

(8) Frank even **only** reads books on focī.

(9) Frank even only reads **books** on **focī**.

(10) Franz even only reads **books** on **focī**.

Here, semantic and phonological focī do not really fit together any more!

1.6. Scalar Implicatures

(11) I passed.

(12) I **passed**.

. . . but could have done better

(13) **I** passed.

. . . the others didn't!

Then everyone else will have aced!

Quantity (Grice (1968))

1. Make your contribution to the conversation as informative as necessary.
2. Do not make your contribution to the conversation more informative than necessary.

Quality

1. Do not say what you believe to be false.
2. Do not say that for which you lack adequate evidence.

[Semantic] Focus theories treat these cases similarly to semantic focī.

2. Empirical Investigations on Focus Constructions

Fundamental Question Which of the effects we observe with 'focus constructions' are really due to focus constructions and which of them are caused by context?

Fundamental Problem Neutral contexts where only effects of focus constructions show are difficult to construct as communication rarely takes place out-of-the-blue and in a setting without any context.

Second Fundamental Problem If you've grown used to a certain reading of a construction, it is fairly difficult to find a new one, even and especially if you are a linguist.

Really Fundamental Problem The empirical foundations of focus theories are shaky.

2.1. *Second Occurrence* Foci̅

2.1.1. Experiment

Hypothesis Generally, precisely pragmatic focī bear focus accents; semantic focī only bear a focus accent if they are also pragmatic focī. Focus accents do not directly semantically disambiguate sentences.

Method In the experiment, 12 test persons were offered recordings of short dialogues which only differed in the accentuation of the last answer. Test persons rated the dialogues for naturality and understandability.

SCHMITZ ET AL. (2001)

2.1.2. The Text

(14) a. Wen hat Peter heute gefüttert?
Whom did Peter feed today?
b. Peter hat heute [nur Mimi] gefüttert.
Today, Peter only fed Mimi.
c. Wer hat sonst noch nur Mimi gefüttert?
Who else only fed Mimi?
d. Anne hat nur Mimi gefüttert.
Anne only fed Mimi.

pragmatic focus — semantic focus

The following words were accentuated:

1. *Anne*
2. *Anne* and *Mimi*
3. *Mimi*
4. *gefüttert*
5. *Mimmi* and *gefüttert*

2.1.3. Variables

independent variables: Accentuation of the words *Anne*, *Mimi*, *gefüttert*

dependent variable: Judgment of naturality and understandability.

2.1.4. Result

Accentuation of constituents that were not focused was rated bad. Dialogues in which only the pragmatic focus was stressed were rated better than those where also or only the semantic focus was accentuated.

2.1.5. Result of the Series of Experiments

The hypothesis was supported by one of three experiments, by the others it was not falsified.

Test subjects avoid constructions with multiple focus.

2.2. Can Focī be Assigned to Contexts?

- two-stage experiment
- focus utterances in picture stories

First Stage How does accentuation work when reading aloud?

Second Stage Do test subjects agree which utterance fits which story?

2.2.1. Variables

First Stage

indendent variable ‘controlled’ context that should focus certain focī

dendent variable Accentuation of ‘interesting’ words

Second Stage

indendent variable Story fits utterance

1. story read — story viewed
2. intonation fits — does not fit sentence

dendent variable Judgment of appropriateness

2.2.2. Result

No statistically significant result.

First Step Accentuation often did not fulfill expectations

Second Step Focus accentuation did not seem to influence appropri-eteness ratings.

3. Experiments

3.1. Considerations when Designing Experiments

test of acceptance Test persons accept a lot.

production experiment test persons refuse to say what we want.

testing interpretation — if possible non-linguistically — seems to be the method of choice.

3.2. Exhaustivity

Well-known Claim: Focī are interpreted exhaustively.

It's all the fault of Grice (1968) and his maxims.

3.2.1. Typical Examples Quoted by Linguists

(15) a. Who of the IKP staff had a beer together yesterday?
b. Bernhard and Bernhard.

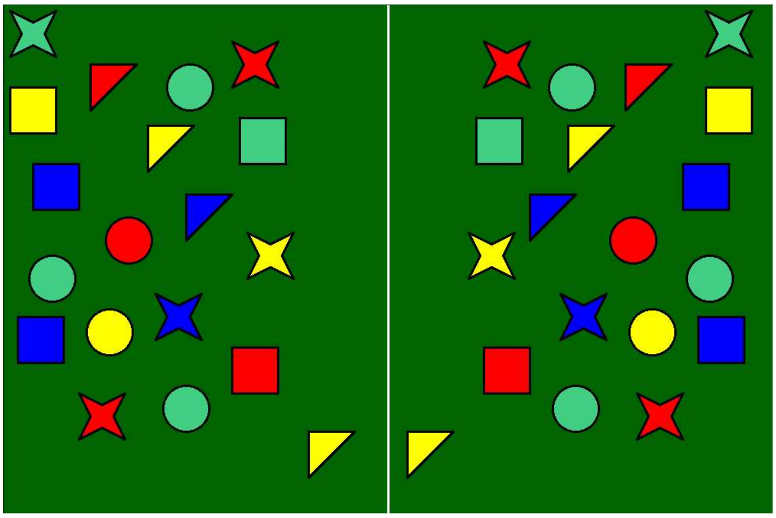
(16) a. Who had a beer together yesterday?
b. Some people of the IKP staff and some participants of the ILLC day from Amsterdam.
c. Bernhard and Bernhard.

Aspects of mention-some answers

- relevance
- competence of the speaker — epistemic force

Should we really generally assume exhaustivity?

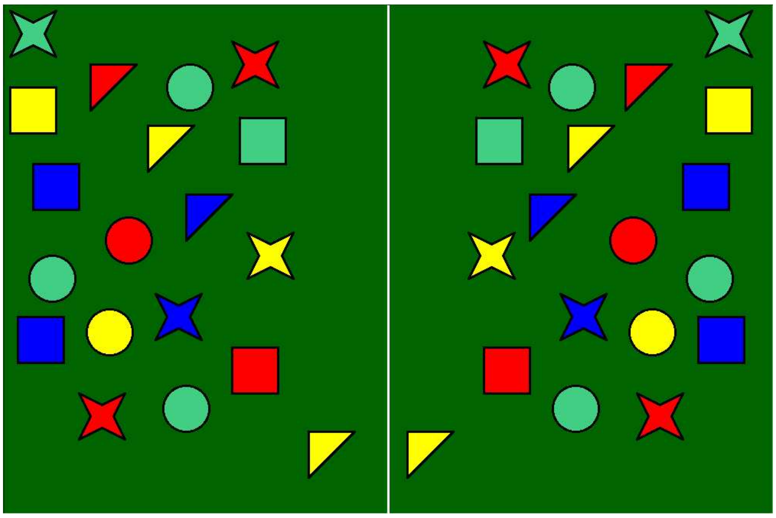
3.2.2. Scenario

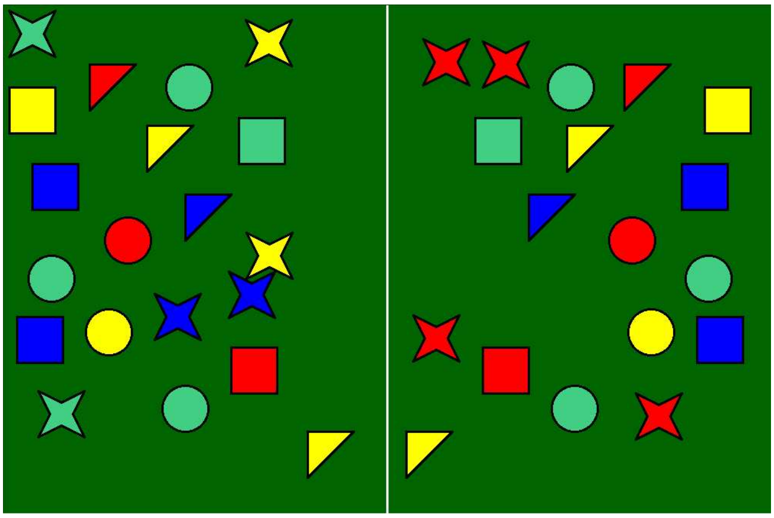


3.2.3. Stimuli

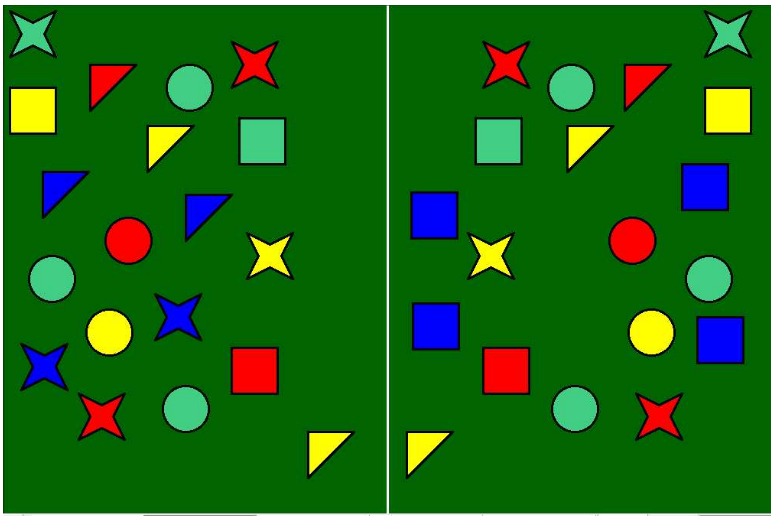
(17) a. Die Sterne, die **rot** sind, befinden sich rechts.
b. Die blauen **Quadrate** befinden sich rechts.
c. Rechts befinden sich die gelben **Kreise**.
d. Rechts befinden sich die Quadrate, die **rot** sind.

(18) a. The stars that are **red** are on the right.
b. The blue **squares** are on the right.
c. The yellow **circles** are on the right.
d. The squares that are **red** are on bright.

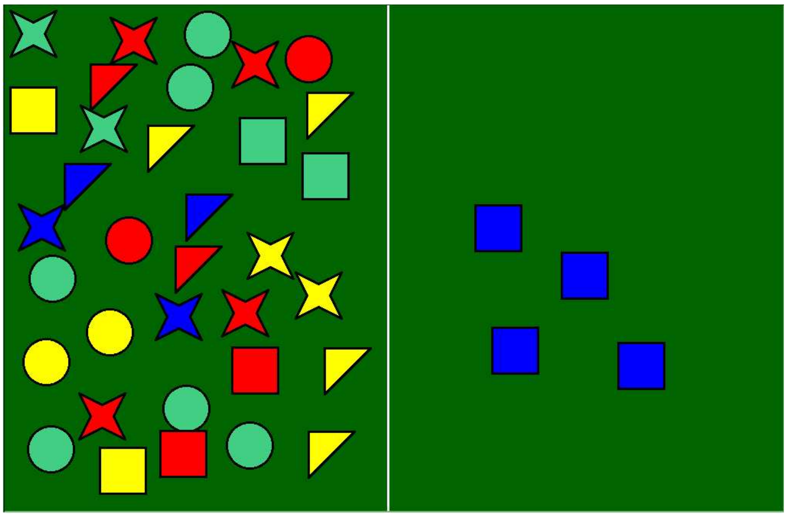




Die Sterne, die **rot** sind, befinden sich rechts.
The stars that are **red** are on the right.



Die blauen **Quadrate** befinden sich rechts.
The blue **squares** are on the right.



Die [blauen **Quadrate**] befinden sich rechts.
The [blue **squares**] are on the right.

3.2.4. Variables

independent variables

- Placement of the focus: pręverbally or postverbally
- medium: written text or (synthesised) speech

dependent variable Exhaustivation of focī, to be 'measured' by placement of the figures

- Is any focus interpreted exhaustively?
- Does focus projection occur?

3.3. Exclusivity under Con-/Disjunction

3.3.1. Typical Examples Quoted by Linguists

(19) a. How many people had what menu in the mensa yesterday?
b. 400 people had menu 1, 600 menu 2 and 80 had salad.

3.3.2. Dubious Examples?

(20) a. How many people had what side-dishes with menu 2 in the mensa yesterday?
b. 310 had chips, 280 potatoes, 400 salad and 190 vegetables.

3.3.3. Scenario

3.3.4. Stimuli

(21) a. Wie haben denn in der Pause die Leute ihren Kaffee getrunken?
b. Zwei Leute hatten **Milch** und drei hatten **Zucker**.
c. Vier Leute hatten **Milch** und vier hatten **Zucker**.

(22) a. How did people drink their coffee in the break?
b. Two had **milk** and three had **sugar**.
c. Four had **milk** and four had **sugar**.

Zwei Leute hatten **Milch** und drei hatten **Zucker**.
Two had **milk** and three had **sugar**.

Vier Leute hatten **Milch** und vier hatten **Zucker**.
Four had **milk** and four had **sugar**.

3.3.5. Variables

independent variables

- compatibility (constantly: yes)
- More cups than items mentioned. (varies)

dependent variables exclusivity of focī in the conjunct

- Do test subjects assign milk and sugar to different 'people' if possible?→
- How do they react if it's not possible?→

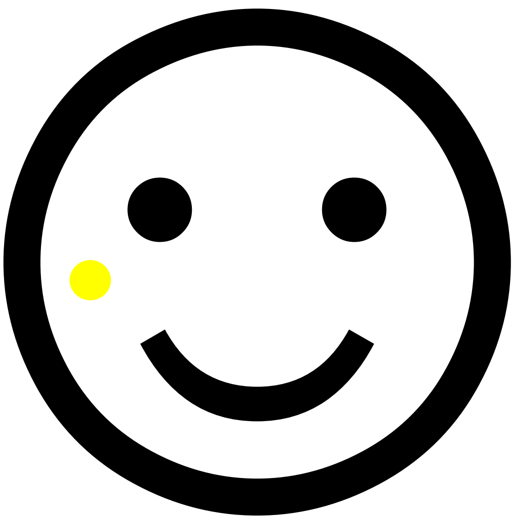
Hypothesis

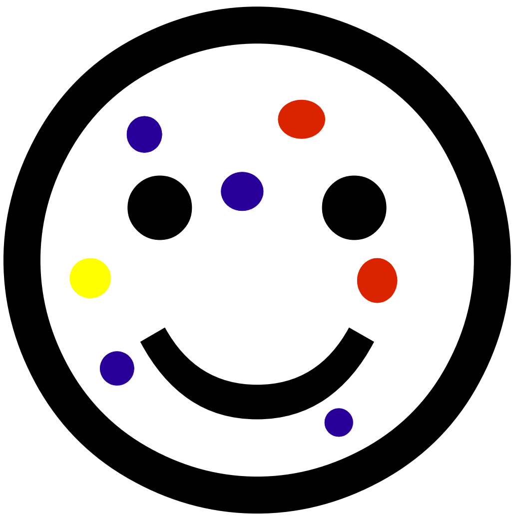
- Inclusive interpretation is (more) acceptable if there are fewer cups than items mentioned.

3.4. Topic/Focus: Sum Reading

3.4.1. Scenario

I suffer from the Really Dangerous Spot Desease. This means that spots appear on my skin and stay forever. Spots that appear on Monday are yellow, Tuesday's spots are red and spots appearing on Wednesday are blue.





3.4.2. Data

(23) On Monday, one spot appeared, on Tuesday two spots appeared, on Wednesday four spots appeared. Thus, I've got seven spots now.
★★★★★★★

(24) On Monday, one spot had appeared, on Tuesday three spots had appeared, on Wednesday seven spots had appeared.
★★★★★★★ — or even ★★★★★★★★★★★?

(25) On Monday, I had one spot, on Tuesday I had three, on Wednesday I had seven. Thus, I've got seven spots now.
★★★★★★★

(26) On Monday, I had one new spot, on Tuesday I had two new spots, on Wednesday I had four new spots.
★★★★★★★

(27) By Monday, one spot had appeared, by Tuesday three spots had appeared, by Wednesday seven spots had appeared.
★★★★★★★

3.4.3. Possible Variables

Do we consider the whole period of time or only moments?

- the kind of verb used (state/action)
- tense
- adverbial phrase indicating time
- NP: is incompatibility indicated?

Conclusion

- Focus constructions are interesting.
- Empirical testing of hypotheses concerning focus constructions is desirable.
- It is not trivial.
- We'll still try.
- Feedback is appreciated!

FINIS

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Neuroevolutionary phenomenology of communicating agents

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Goal of the project: Evolution of communication

- Communication is evolutionarily complex!
  - late evolution
- Communication is evolutionarily simple!
  - It evolves as soon as needed.
- Answer depends much on the concept of communication.
  - Shannon-like information transfer
  - intentional knowledge transfer (gradual notion)
  - animal communication: different degrees of intentionality and knowledge

Contents

Principles of the project

- Artificial evolution of communicative behavior
- Extremely reduced environment
- Extremely reduced sensomotoric capabilities
- Controllable evolutionary conditions
- Kind of neural substrate is quite arbitrary

Basic questions

- Evolution of communication
- Evolution of specific communicative acts
  - imperatives,
  - questions,
  - assertions
- Evolution of meaning / concepts
- Evolution of pragmasemantics
  - Maxims of conversation, implicatures
  - Robustness of communication

Two kinds of development

- ontogenetic development: learning
- phylogenetic development: evolution
- sharpness of the distinction rests on the precise definition of the individual whose lifecycle is considered
- A capacity can evolve within an agent or a society of agents, it's evolution is not depend on agent evolution.

Biology vs engineering

Neurodynamic evolution can be viewed as providing

- a model for biological evolution,
- an engineering tool for the development of robust economical systems for some predefined tasks.

The evolution can be viewed more or less abstract wrt physical and biological conditions.

The implementation

The environment

- agents moving in a two dimensional environment with different types of entities
  - “food”
  - “walls”

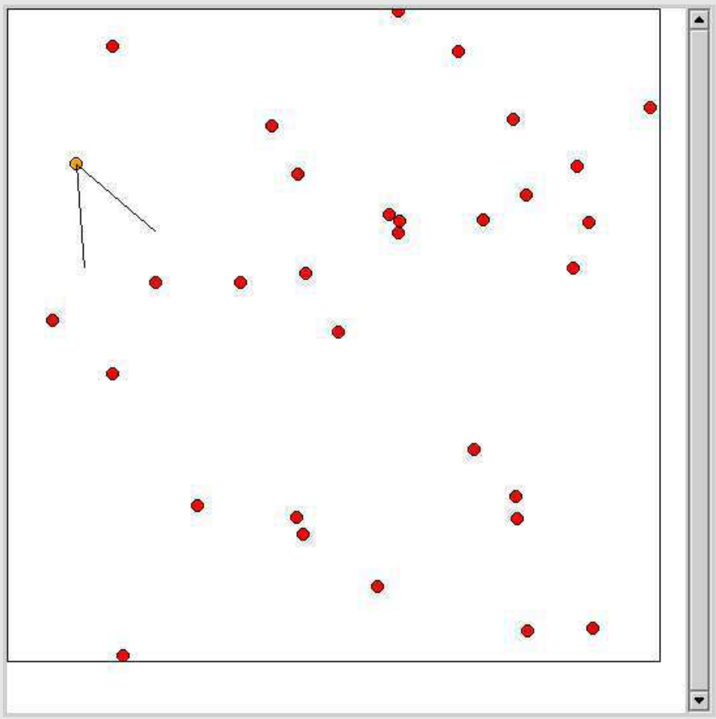

Figure 1: The agents’ world

The agents

- food-related goals
- agents perceive the entities of their environment
- agents move within their environment
- sensomotoric relation completely defined by a neural network
- synaptic structure does not change during lifetime of an agent (no built-in learning mechanism)

Constant synaptic structure does not preclude adaption/learning during lifetime!

But you do not get learning for free!

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The evolution

- mutation: random change of the neural structure of an agent
- evaluation: measuring the fitness of an agent
- selection: reproduction according to fitness

examples: n3,0; dump1:99th gen

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The structure of the agents

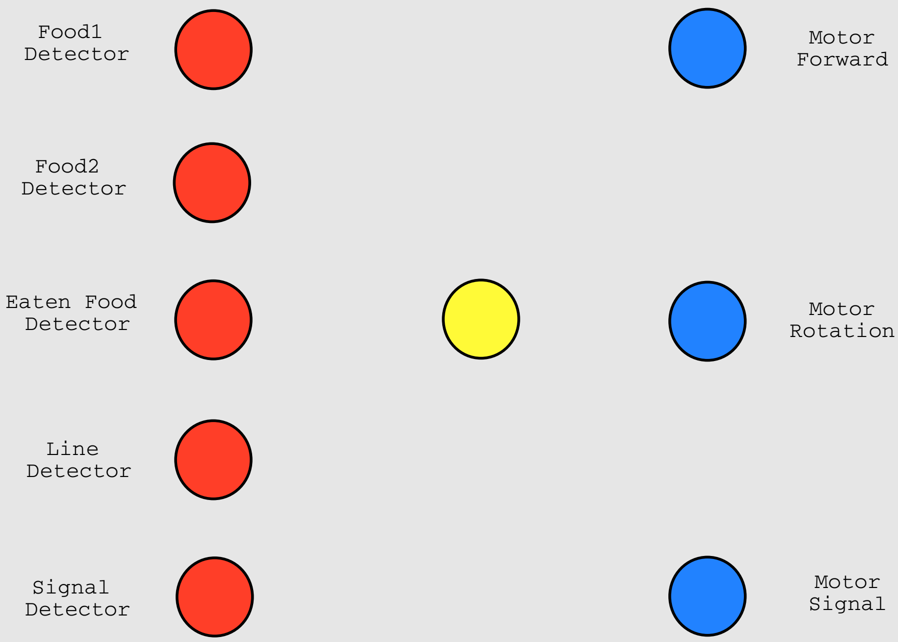

Figure 2: Base neurons.

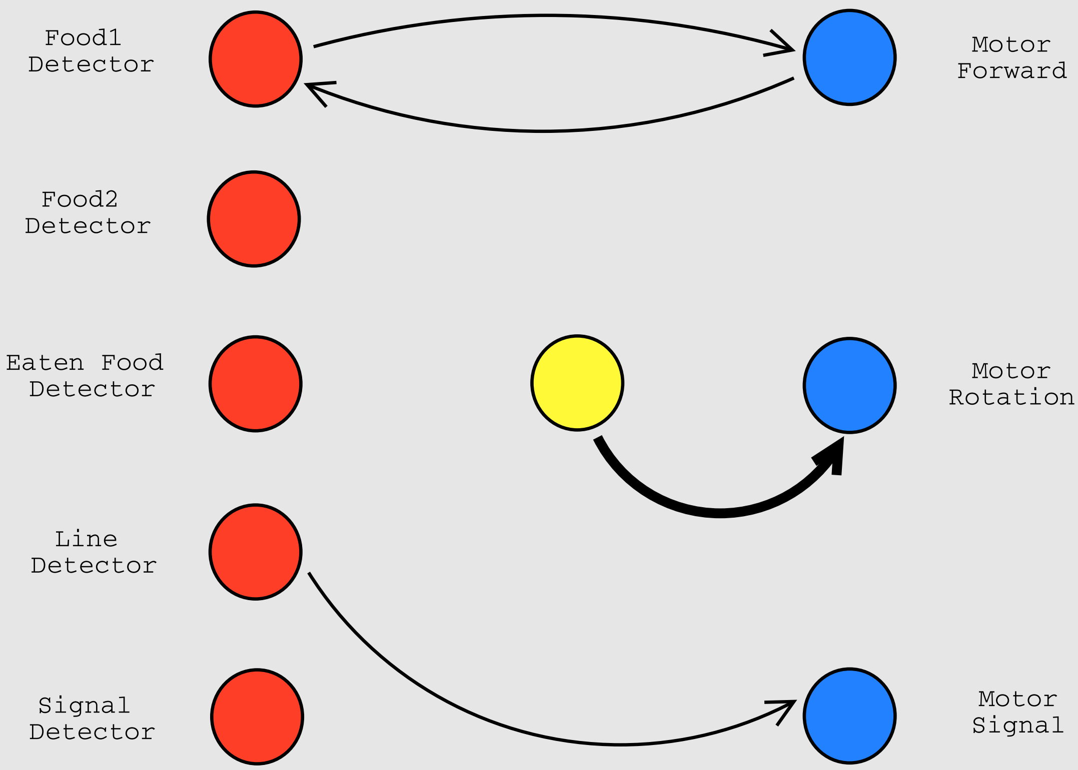

Figure 3: Base neurons with synapses.

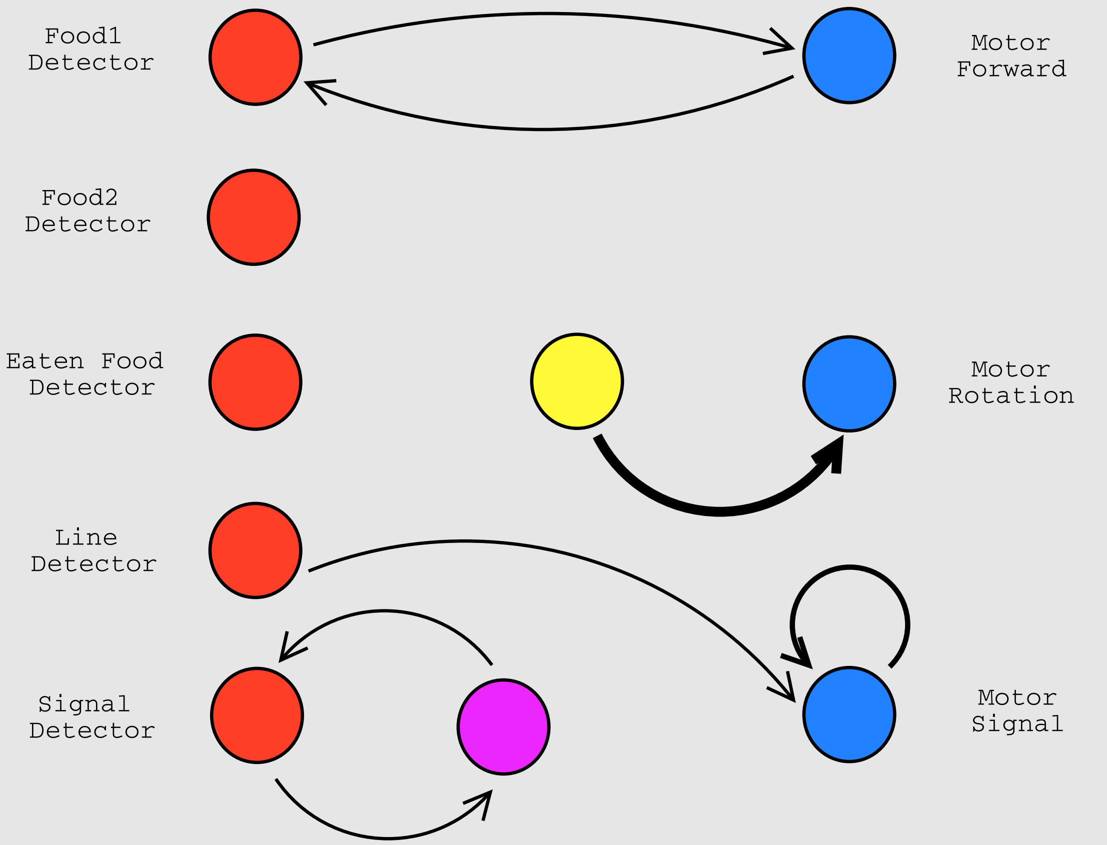

Figure 4: Random mutations

The structure of the neurons

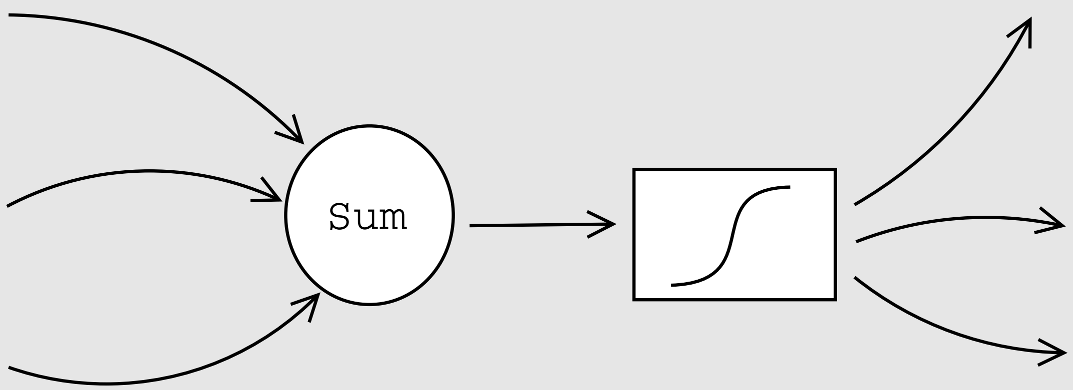

Figure 5: Structure of neurons

Computation of neural states

$$s_{i,t'} = \sigma(p_i + \sum_j w_{i,j} s_{j,t}) \quad (1)$$

$$\sigma : \mathbb{R} \mapsto [1, -1] \quad (2)$$

$$\sigma(x) := \frac{2}{1 - e^{-x}} - 1 \quad (3)$$

$s_{i,t}$: activation of neuron i at time t

$w_{i,j}$: weight of synapsis from neuron i to neuron j, may be negative (inhibitory)

p_i: sensory input to neuron i

Sensory input

$$p_i = \sum_{e \in V} (\left(\frac{\delta_e}{\delta_h}\right)^2 + 1)^{-1} + \nu \quad (4)$$

$$0 < (\left(\frac{\delta_e}{\delta_h}\right)^2 + 1)^{-1} \leq 1 \quad (5)$$

V: set of visible entities

δ_e: distance of entity e

δ_h: distance of half intensity

ν: noise

downward monotonous wrt distance δ_e

perception and memory

Multiagent societies

- Agents in each society share internal structure
- Social tasks, coordination needed
- Agents perceive each other

examples: dump6_gen11, dump6_gen20

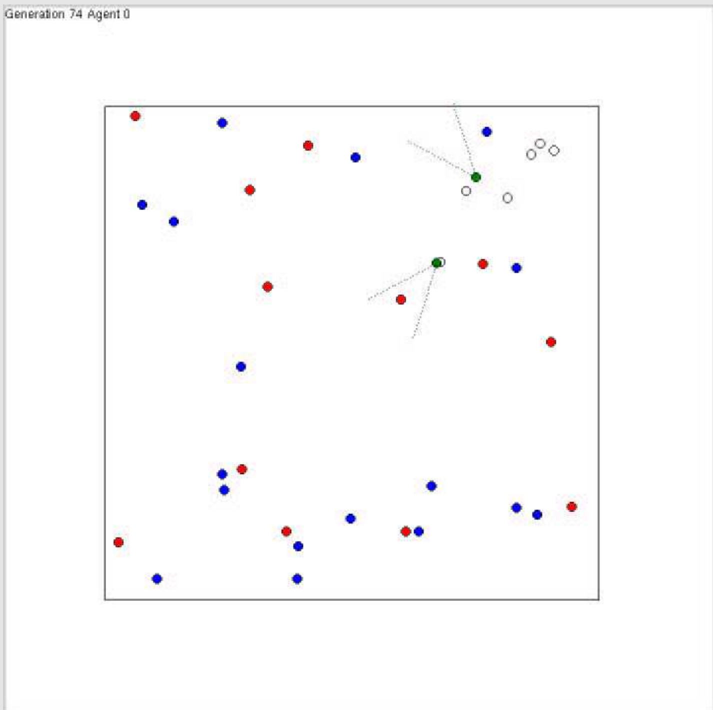

Figure 6: The world of an agent society

Evolution

- Mutation
- Evaluation
- Selection

Fitness

$$F = -N + \sum_{a\in\{1,2\},c\in\{r,b\}} e_{a,c} - \prod_{a\in\{1,2\}} e_{a,r} - e_{a,b} \quad (6)$$

Fitness is high if each agent concentrates

- on a specific kind of food
- different from the other agent.

Mutation

$$A_{n+1} = \{a_m | \exists a[a \in \mathbf{Fittest}_i(A_n) \wedge a_m \in \mathbf{Mut}_j(a)]\} \quad (7)$$

- n: number of generation
- A_n: set of agents of generation n
- $\mathbf{Fittest}_i(A)$: set of the i fittest agents of A
- $\mathbf{Mut}_j(a)$: set of j mutants of agent a

Evolutionary parameters

- sensomotoric structure of agents
- fitness function
- mutation rate (costs of mutations: new neurons, synaptic changes)
- episode length
- variation of situations
- number of agents per generation
- selection function

Evolutionary milestones

3rd generation: movement

8th generation: forward movement

11th generation: avoid hitting an obstacle

12th generation: seeking of food

30th generation: strongly differing behavior

60th generation: agents informing each other about division of labor

No clear forms should be expected in early development. Evolved strategies are very situation specific.

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Evolutionary phenomenology

Signalling

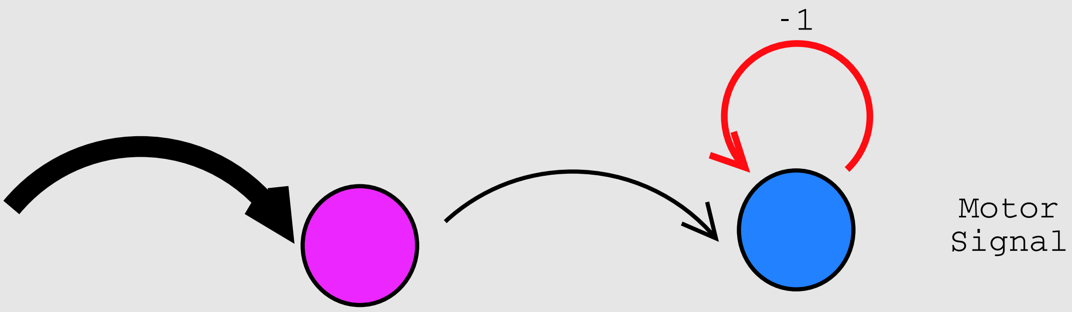


Figure 7: Blinking signal, period=2

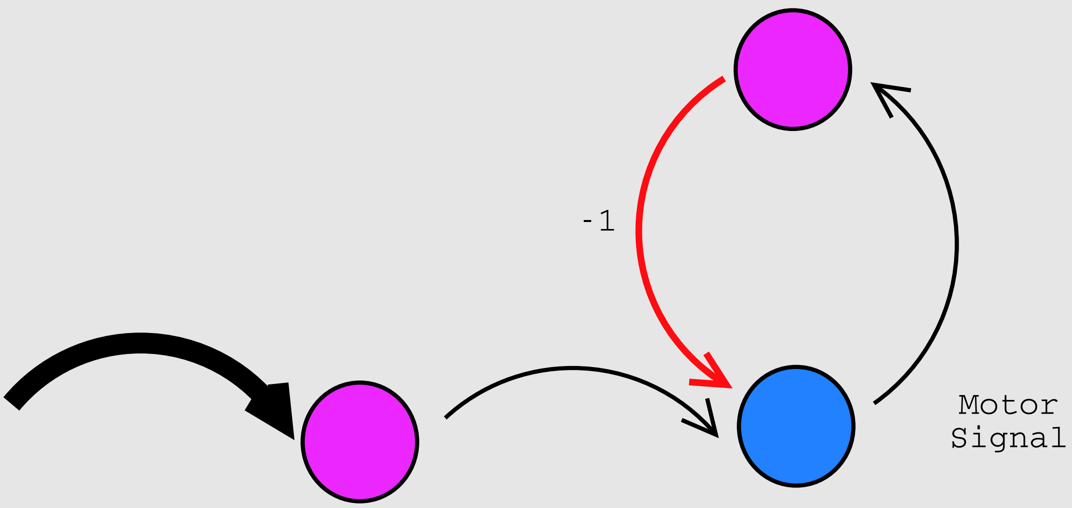


Figure 8: Blinking signal, period=4

Detecting signals

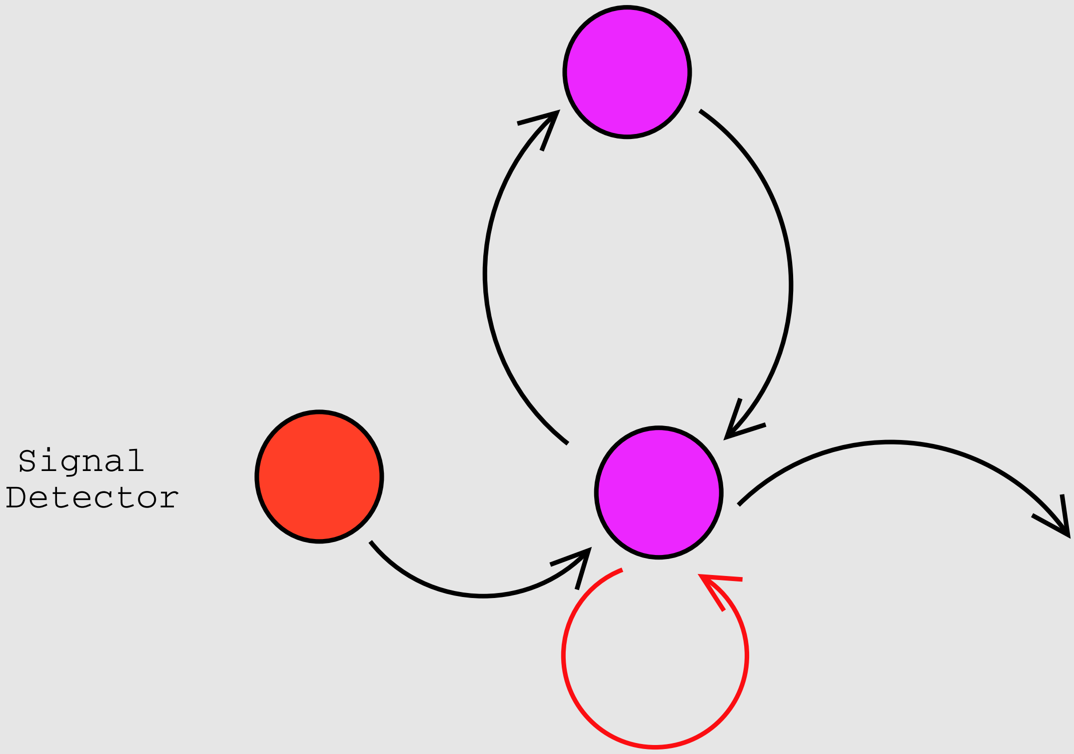


Figure 9: Detecting blinking signal, period=2

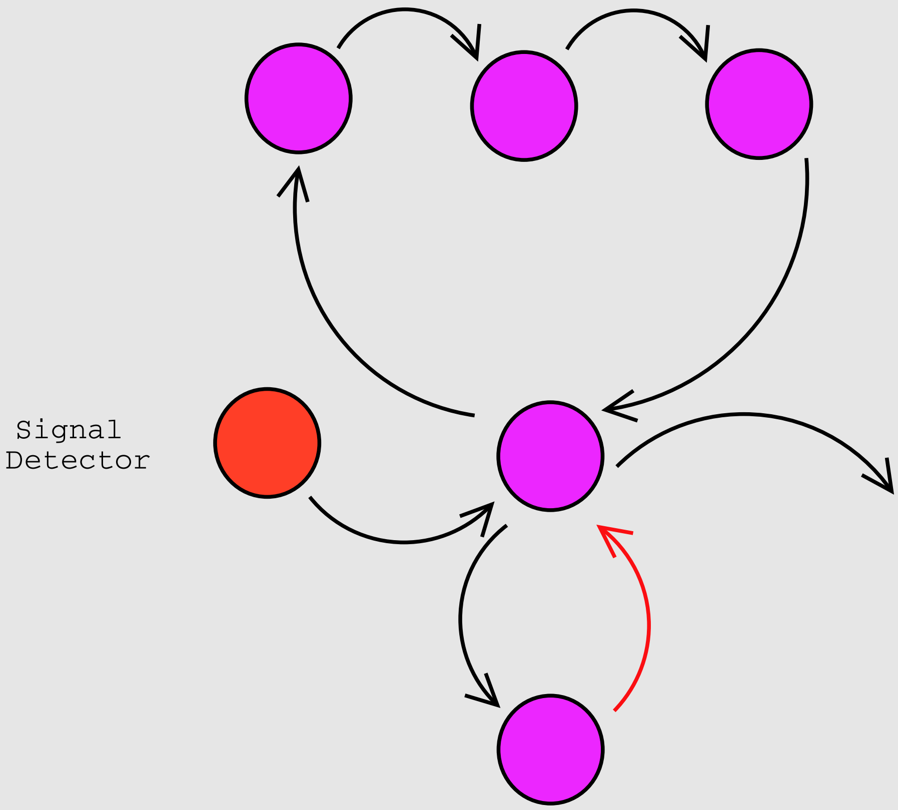


Figure 10: Detecting blinking signal, period=2

Switches

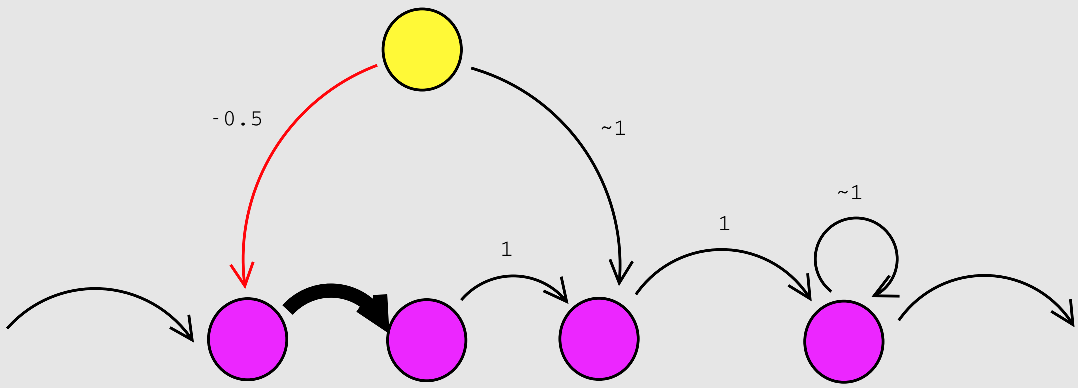


Figure 11: Switch

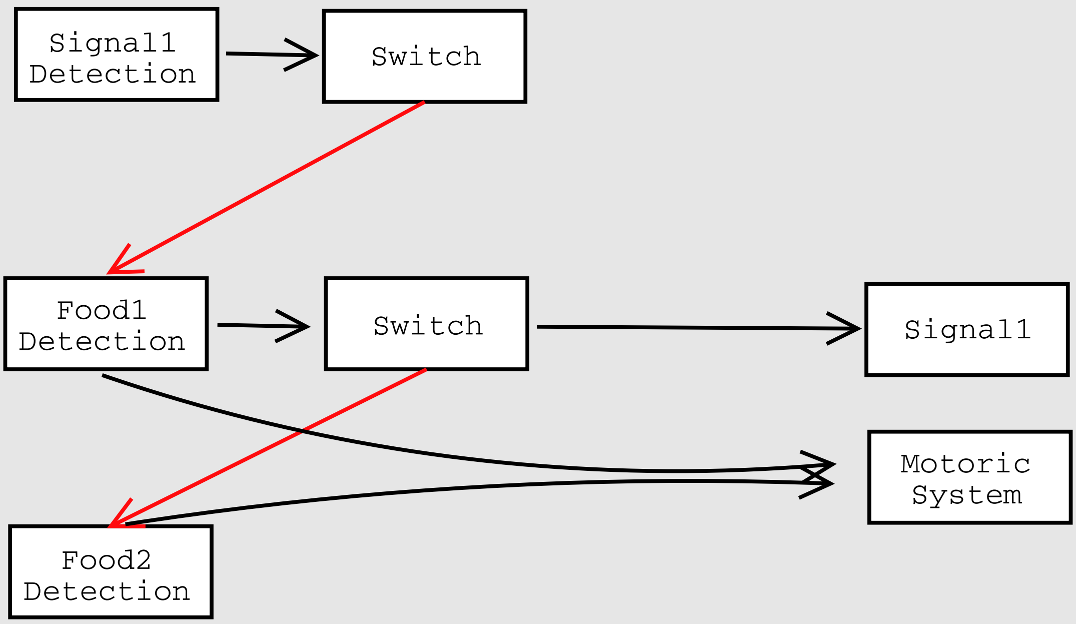


Figure 12: Structure of an agent

Networks in reality

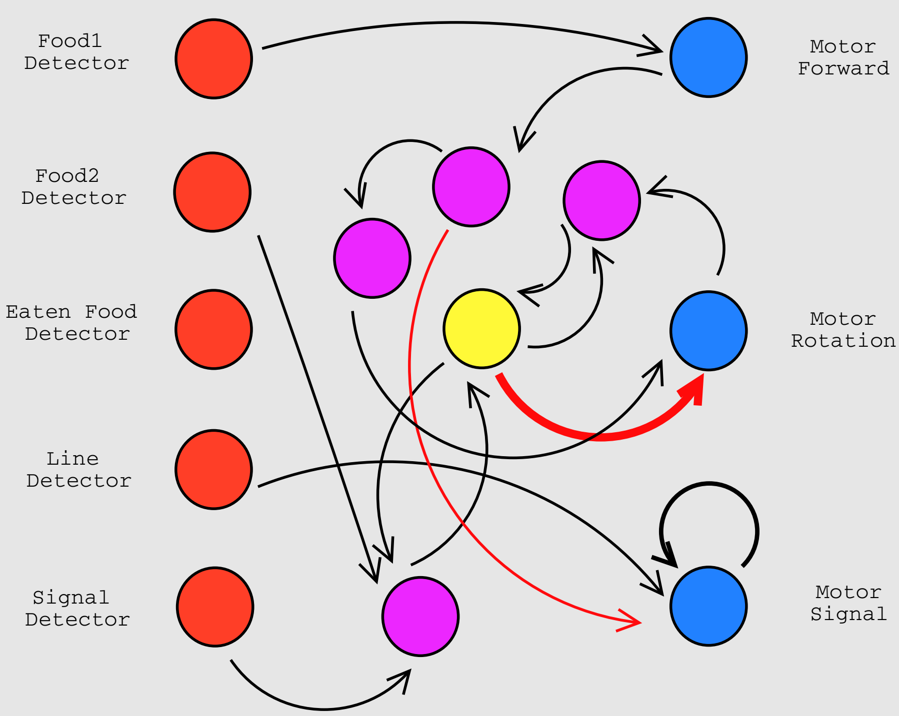


Figure 13: Network in reality

Some extrapolations

Human(-like) communication is characterized by

- syntactic complexity,
- use of / relatedness to concepts and knowledge.

Syntactic complexity

- combinatorial complexity:
  - number of distinguishable item,
  - combining items.

  Related to goals which need highly differentiating communication.
  - neural implementation: intermediate layer with many neurons

Concepts and knowledge

- stimulus-response indirectness:
  - motions are not related to perceptions in a simple and transparent way,
  - stimulus-response relation is adaptive.

  Related too goals which presuppose
  - a history of perceptions (experience),
  - complex computations (reasoning).
  - neural implementation: many intermediate layers

Conclusion

Neurodynamic evolution of communicative behavior

- can evolve in minimalistic environments,
- is not much more complex than the evolution of other sensomotoric capacities,
- needs limited neural ressources.

Definition of tasks and setting of evolutionary parameters is crucial for the speed and the success of the evolution.

Common knowledge in conversation

Piotr Labenz

6th June 2004

Df.1. The proposition p is common knowledge (CK) among the members of C iff

$$\forall x \in C\, \Box_x p,$$

$$\forall x \in C\, \forall y \in C\, \Box_x \Box_y\ p,$$

$$\forall x \in C\, \forall y \in C\, \forall z \in C\, \Box_x \Box_y \Box_z\ p$$

etc. ad infinitum ■

(thus Schiffer 1972 and epistemic logics)

Hypothesis: CK indispensable for communication

In order for me to felicitously utter p, its presuppositions must be CK among my interlocutors. (Lewis 1969)

In other words: for the members of C to communicate in language L, the meaning postulates of L must be common knowledge among them.

Otherwise always a risk that an utterance would not be felicitous – by domino effect over $\Box$-depth.

Paradox: CK computationally impossible (Clark and Marshall 1981)

In order to be sure that my utterance of p will be felicitous, I must check that p's presuppositions are CK.

But, by definition of CK, that amounts to checking an infinite number of sentences.

That cannot be done in a finite time, so I can never be sure that I'll utter p felicitously.

Yet usually we are quite certain about the felicity of what we are going to say. A contradiction.

Df.2. p is CK among the members of C at the world w_0 iff

$$\forall w\ R^*(w_0, w) \to w \models p$$

where R^* is the transitive closure of accessibility relations of all the members of C. ■

Hence p is CK iff p is true at all non-solitary worlds. If there are finitely many of those, the paradox is solved.

Nevertheless, this is cognitively implausible – because we have to scan the entire model.

Df.3. p is CK among the members of C iff a basis B exists s.t.

$$\forall x \in C\ \forall p \in B\ \Box_x p$$

where

$$B \models (p \wedge \forall x \in C\ \forall p \in B\ \Box_x p).$$

■ (Lewis 1962, Aumann 1976)

Psychologically more realistic – B a shared basis (Clark 1996). Enough to give a B to check CK.

However, this is non-categorical: unintended B-s are possible. Thus it is impossible to check finitely whether p is *not* CK.

Df.4. p is CK among the members of C if q obtains s.t.:

$$q \to \forall x \in C\, \Box_x (p \wedge q).$$

■ (Barwise 1989)

Such q describes a coordination device, e.g. the presence of a salient object in the common visual field – or a linguistic convention.

However, checking whether p is CK proceeds as for Df.2. – for the negative case the entire model must be scanned.

But: from the psychological point of view, there are finitely many coordination devices. So actually the search space is limited.

Question: how to restrict the set of eligible q-s?

Coordination through evolution

An answer: by saying what is the strategy behind treating coordination devices as sources of CK. Then the set of q-s will be delimited by the availability of such strategy.

Assume I am talking with b, so $C = \{b, \text{me}\}$. Let action $\mathbf{p}$ be uttering the presupposition p; let $\alpha, \beta, \gamma \in \mathbb{R}_+$ be utilities. We face a decision problem:

	$\Box_b p$	$\neg\Box_b p$
$\mathbf{p}$	$-\alpha$	β
$\bar{\mathbf{p}}$	β	$-\gamma$

Cf. the quantity principle.

	$\Box_b p$	$\neg\Box_b p$
$\mathbf{p}$	$-\alpha$	β
$\bar{\mathbf{p}}$	β	$-\gamma$

Let EU – expected utility, P – probability:

$$EU(\mathbf{p}) = P(\Box_b p) \cdot -\alpha + (1 - P(\Box_b p)) \cdot \beta \; = \; \beta - P(\Box_b p)(\beta + \alpha)$$

$$EU(\bar{\mathbf{p}}) = P(\Box_b p) \cdot \beta + (1 - P(\Box_b p)) \cdot \gamma \; = \; P(\Box_b p)(\beta + \gamma) - \gamma$$

Thus in the long run if I am guessing about what b might know, the optimal strategy will be mixed:

$$EU(\mathbf{p}) > EU(\bar{\mathbf{p}}) \quad \text{iff} \quad P(\Box_b p) < \frac{\beta + \gamma}{2\beta + \gamma + \alpha}$$

Call it $\mathbf{m}$.

But my interlocutor b is in a symmetric situation. (A strong, but plausible assumption.) So she will also use $\mathbf{m}$; using some other $\bar{\mathbf{m}}$ must yield smaller EU, so for $\delta > \eta$:

	$\mathbf{m}$	$\bar{\mathbf{m}}$
$\mathbf{m}$	δ, δ	δ, η
$\bar{\mathbf{m}}$	η, η	η, δ

Summing the utilities for both me and b, we have a common utility from C's group perspective. Then:

$$U(\mathbf{m}, \bar{\mathbf{m}}) \leq U(\mathbf{m}, \mathbf{m})$$

$$U(\bar{\mathbf{m}}, \mathbf{m}) = U(\mathbf{m}, \mathbf{m}) \rightarrow U(\bar{\mathbf{m}}, \bar{\mathbf{m}}) < U(\mathbf{m}, \bar{\mathbf{m}})$$

So $\mathbf{m}$ is an evolutionarily stable strategy (ESS).

If one can use $\mathbf{m}$, one will use it; converse trivially. One can use it iff one is good at guessing the probabilities of what others in C know. So whoever uses $\mathbf{m}$ is good at guessing that – which amounts to using coordination devices.

Df.5. p is CK among the members of C if q obtains s.t.:

$$q \to \forall x \in C\, \Box_x (p \wedge q).$$

where q holds because of an ESS employed by the members of C. ■

This restricts the search space while checking CK to the set of ESS-s used in C, which is finite and an empirical question.

Signaling games and non-literal meaning

Merlijn Sevenster

ILLC, UvA

June 7th, 2004

Outline of this talk

Main topics:

- Game theoretical notions help to model different linguistic phenomena
- Experimental results of Game theory shed light on the use of language

This talk:

- Introduction to signaling games
- Pay-off dominant equilibria
- *Super conventional signaling games*
- Risk dominant equilibria
- Experiments w.r.t. risk dominance
- Facts on SC signaling games
- Predictions
- Conclusion and future research

Signaling games

Quine (1936): How can meaning of language be conventionalized without presupposing meaning?

Lewis (1963): Consider meaning the result of playing *signaling games* rationally.

Though, Rubinstein: "[...] if game theory is to shed light on real life phenomena, linguistic phenomena are the most promising candidates. Game theoretical solution concepts are most suited to stable life situations which are "played" often by large populations of players."

Signaling games, extensively

Structure of the game:

First, Nature picks state $t \in T$

Second, sender S knowing t sends a message $m \in M$ to receiver R

Third, receiver R knowing only m performs an action $a \in A$

Payoff w.r.t. t, m, a*:*

Every state t calls for an appropriate action $f(t) \in A$:

$$\mathsf{u_S}(t,m,a) = \mathsf{u_R}(t,m,a) = \begin{cases} 1, & \text{if } a = f(t) \\ 0, & \text{if } a \neq f(t) \end{cases}$$

Nash equilibrium

A pair of strategies $\langle \mathbf{s}^*, \mathbf{r}^* \rangle$ is a *Nash equilibrium*, if for all strategies $\mathbf{s}$ and $\mathbf{r}$

$$U_S(\mathbf{s}^*, \mathbf{r}^*) \geq U_S(\mathbf{s}, \mathbf{r}^*)$$

and

$$U_R(\mathbf{s}^*, \mathbf{r}^*) \geq U_R(\mathbf{s}^*, \mathbf{r}).$$

Pay-off dominance

A pair of strategies $\langle \mathbf{s}^*, \mathbf{r}^* \rangle$ is a *pay-off dominant Nash equilibrium*, if for all Nash equilibria $\langle \mathbf{s}, \mathbf{r} \rangle$

$$U_S(\mathbf{s}^*, \mathbf{r}^*) \geq U_S(\mathbf{s}, \mathbf{r})$$

and

$$U_R(\mathbf{s}^*, \mathbf{r}^*) \geq U_R(\mathbf{s}, \mathbf{r}).$$

Lewis: The eventual pay-off dominant Nash equilibrium (*signaling system*) represents the conventional meaning.

Wärneryd (1993) gives a evolutionary characterization for pay-off dominant Nash equilibria.

Non-literal speech

Signaling system $\langle \mathbf{s}, \mathbf{r} \rangle$ accounts for meaning of $\mathbf{s}(T)$. But can only account for their *literal* meaning.

Substantial amount of speech is *non-literal*, e.g.

Metaphor:
"George Bush is a pig"

Irony:
"He is even more hansom than Brad Pitt"

Euphemism:
"Bill Gates is not very poor"

Typically a message m is used non-literally if it intends to communicate state t that is conventionally communicated by means of message m', where $m \neq m'$.

Non-literal speech is risky

Rewards of non-literal speech:

Social: politeness, face-saving, emphasizing and reinforcing claims to common ground

Cognitive: non-literal utterances are more deeply embedded in the audience's memory and have long-term effects that literal utterances have not

Efficiency

Risks of non-literal speech:

Social: Sally (2003): "A mismatch [...] between close [interlocutors] signals a problem with the relationship and may cause strong negative emotions and distancing"

Efficiency: parts of conversation have to be reconstructed

Risk dominance

In Game theory "risky equilibria" are modeled by notion of *risk dominance*, as opposed to pay-off dominance.

Harsanyi & Selten (1988): $\langle s^*, r^* \rangle$ is a risk dominant Nash equilibrium, if for all Nash equilibria $\langle s, r \rangle$

$$(U_S(s^*, r^*) - U_S(s, r^*))(U_R(s^*, r^*) - U_R(s^*, r))$$
$$\geq$$
$$(U_S(s, r) - U_S(s^*, r))(U_R(s, r) - U_R(s, r^*))$$

Typically, risk dominant equilibria provide better outcomes in worst-case scenarios.

	r^*	r
s^*	2, 2	2, 0
s	0, 2	3, 3

Two scenarios

Scenario A: Suppose you are playing the game with an arbitrary, unknown opponent.

Scenario B: Suppose you are playing the game with your best friend.

	r	r'
s	10, 10	10, 0
s'	0, 10	15, 15

What would you do?

Two rules of thumb

Harsanyi and Selten thought that players first coordinate on pay-off dominant equilibria. And that, if none are available, they coordinate on risk dominant equilibria. However, experimental Game theory has proven this conjecture false.

Rule 1: In a game with one outcome risk dominant and another "modestly" pay-off dominant, the former is more likely to be chosen.

Rule 2: As sympathy between the players increases, a pay-off dominant, risk dominated equilibrium is more likely to be realized.

Three facts

Fact 1 If $\langle \mathrm{s}, \mathrm{r} \rangle$ is a signaling system, then $\langle \mathrm{s}, \mathrm{r} \rangle$ is a Nash equilibrium

Fact 2 $\langle \mathrm{s}, \mathrm{r} \rangle$ is a pay-off dominant Nash equilibrium iff $\langle \mathrm{s}, \mathrm{r} \rangle$ is a signaling system and for every $t \in T$ it is the case that $\mathrm{s}(t) \neq \mathbf{c}\mathrm{s}(t)$

Fact 3 If $\epsilon' > \epsilon$, then $\langle \mathrm{s}, \mathrm{r} \rangle$ is risk dominant iff $\mathrm{s} = \mathbf{c}\mathrm{s}$ and $\mathrm{r} = \mathbf{c}\mathrm{r}$.

Rule 1 and 2 applied

Rule 1: In a game with one outcome risk dominant and another "modestly" pay-off dominant, the former is more likely to be chosen.

Rule 2: As sympathy between the players increases, a pay-off dominant, risk dominated equilibrium is more likely to be realized.

Sally (2003): "[...] people play the language game in a way that is consistent with their play in all games."

Prediction *Rule 1*: Interlocutors communicate according to the convention, by default

Prediction *Rule 2*: As sympathy between interlocutors increases, the more likely they are to communicate non-literally.

Conclusion

• Solution concepts characterize linguistic phenomena

• Risk dominance is suited to model non-literal speech

• Game theoretical considerations concerning primacy of solution concept are of interest to pragmatics

Future research

- SC signaling games are not sensitive to metaphors, irony, euphemisms, etc.

- Formalization of the notion of sympathy/ common ground that seems crucial in *Rule 1* and *2*

- Risk dominance applied to other linguistic phenomena, such as the use of pronouns

- What solution concepts have what linguistic counterparts?

NET

on Neural Network Interpretations of OT

Oren Schwartz

LEGO, May 28, 2004

Credits

Melanie Soderstrom	(Brown)
Don Mathis	(Hopkins)
Paul Smolensky	(Hopkins)

Introduction

- Optimality Theory
  - A symbolic theory from subsymbolic observations
- CV Theory: a toy domain
  - Simplified syllabification (skeletal subset of phonology)
  - Representations of forms and constraints are simple
  - Known linguistic typology
  - Productivity -- unbounded combinatorial structure
- CVNet
  - A neural network implementation

Optimality Theory

- Candidates
  - Input - Output structures
- Constraints
  - universal
  - violable
  - ranked
- Typology
  - re-ranking of constraints.

CV Theory

- Syllabification
- Candidates
  - Input / Output

Input	Output	
$/C^1V^2C^3C^4/$	$[.C^1V^2.C^3\mathbf{V}c^4.]$	(epenthesis)
/paed + d/	[.paed.ed.]	
$/C^1V^2C^3\mathbf{C}^4/$	$[.C^1V^2c^3.]$	(deletion)
/fish + s/	[fish]	

CV Theory

- CON: Constraints

PARSE	- for every element in the input there is a corresponding element in the output.
FILL_V	- every nucleus in the output has a corresponding element in the input.
FILL_C	- every consonant in the output has a corresponding element in the input.
ONSET	- every syllable nucleus has a preceding onset.
NOCODA	- there are no syllable Codas.

CV Theory

- GEN: “Inviolable” Constraints

IDENTITY	- each correspondence index may label at most one pairing
LINEARITY	- output segments maintain the order of their corresponding input segments
INTEGRITY	- each segment in the input corresponds to at most one segment in the output
UNIFORMITY	- each segment in the output corresponds to at most one segment in the input.

CV Theory

- GEN: Structural Constraints

$\text{IDENTITY}_{\text{Output}}$	- each output segment may be an onset, nucleus, or coda, but only one at a time.
NOGAPS	- no gaps between consecutive segments of an output string
NUCLEUS	- every onset must be followed by a nucleus and every coda must be preceded by a nucleus
CORRESPONDENCE	- no correspondence relation exists without both an input and output segment

$/C^1V^2C^3C^4/$ $[.C^1V^2.C^3\mathbf{V}c^4.]$ (epenthesis)

/paed + d/ [.paed.ed.]

/paed + d/ $/C^1V^2C^3C^4/$	NoCODA	FILLv	PARSE
$[.C^1V^2.C^3\mathbf{V}c^4.]$ [.paed.ed.]		*	
$[.C^1V^2.C^3V.]$		*	*!
$[.C^1V^2c^3.]$	*!		*

$/C^1V^2C^3C^4/$ $[.C^1V^2.C^3\mathbf{V}c^4.]$ (deletion)

/paed + d/ [.paed.ed.]

/paed + d/ $/C^1V^2C^3C^4/$	FILLv	NoCODA	PARSE
$[.C^1V^2.C^3\mathbf{V}c^4.]$ [.paed.ed.]	*!		
$[.C^1V^2.C^3V.]$	*		*!
$[.C^1V^2c^3.]$		*	*

CV Theory: Typology

PARSE >> FILL$_C$ >> **FILL$_V$ >> NOCODA** >> ONSET

no deletion. no epenthesis.

/$V^1C^2C^3V^4$/ [.$V^1c.C^2V^4$.]

/ipso/ [.ip.so.]

PARSE >> FILL$_C$ >> **NOCODA >> FILL$_V$** >> ONSET

no deletion. epenthesize vowels to avoid codas.

/$V^1C^2C^3V^4$/ [.$V^1.C^2$**V**.C^3V^4.]

/ipso/ [.i.pu.so.]

CV Theory: Typology

FILL$_V$ >> PARSE >> ONSET >> FILL$_C$ >> NOCODA

no vowel epenthesis.

/$C^1V^2C^3C^4$/ [.$C^1V^2.c^3$]

/fish+s/ [.fish.]

FILL$_C$ >> PARSE >> ONSET >> FILL$_V$ >> NOCODA

vowel epenthesis, but no consonant epenthesis.

/$C^1V^2C^3C^4$/ [.$C^1V^2.C^3Vc^4$.]

/fish+s/ [.fi.shes.]

CV Theory: Typology

PARSE >> **FILL$_V$ >> NOCODA** >> ONSET >> FILL$_C$

Codas allowed.

/$C^1V^2C^3$/	[.$C^1V^2c^3$.]
/cat/	[.cat.]

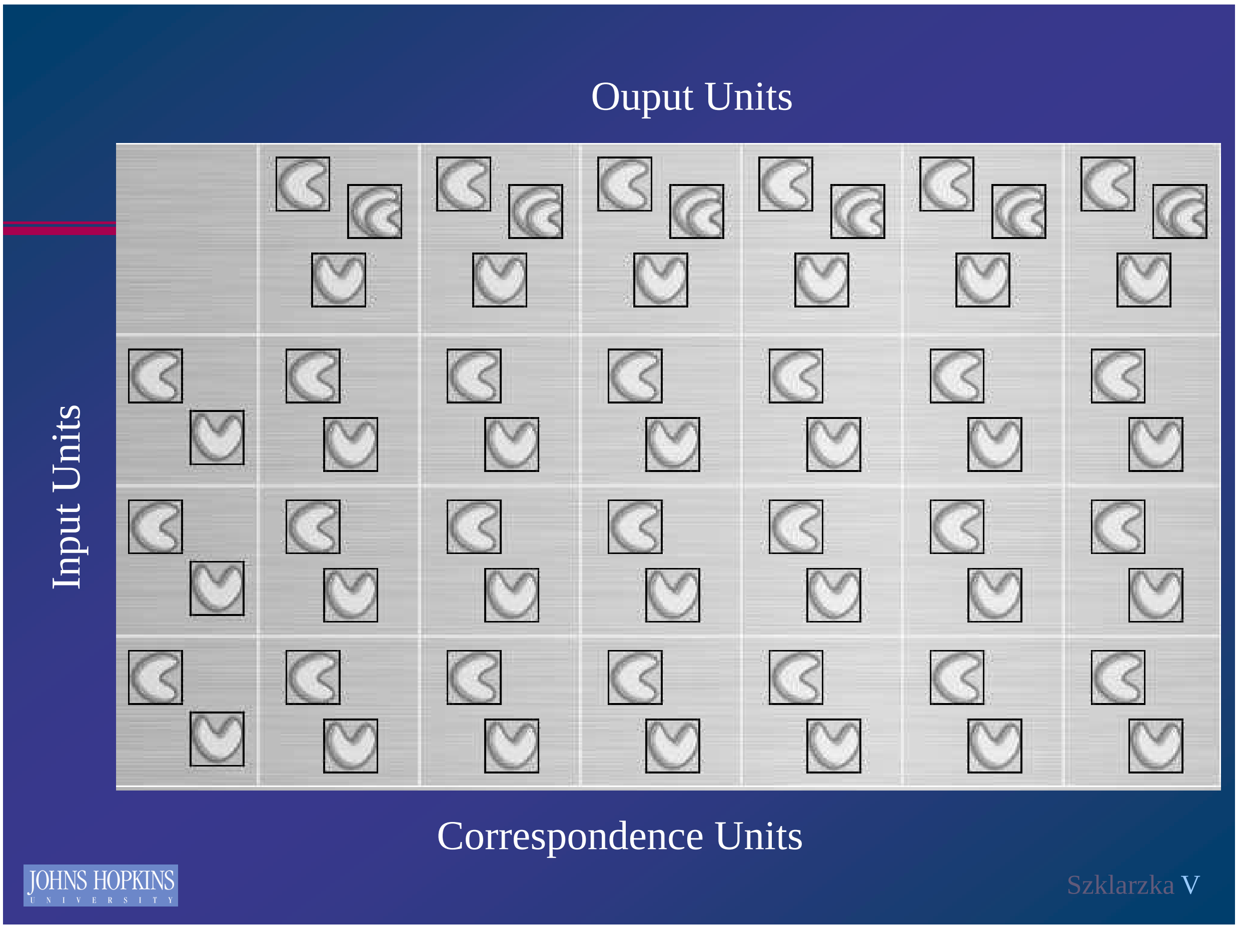
PARSE >> **NOCODA >> FILL$_V$** >> ONSET >> FILL$_C$

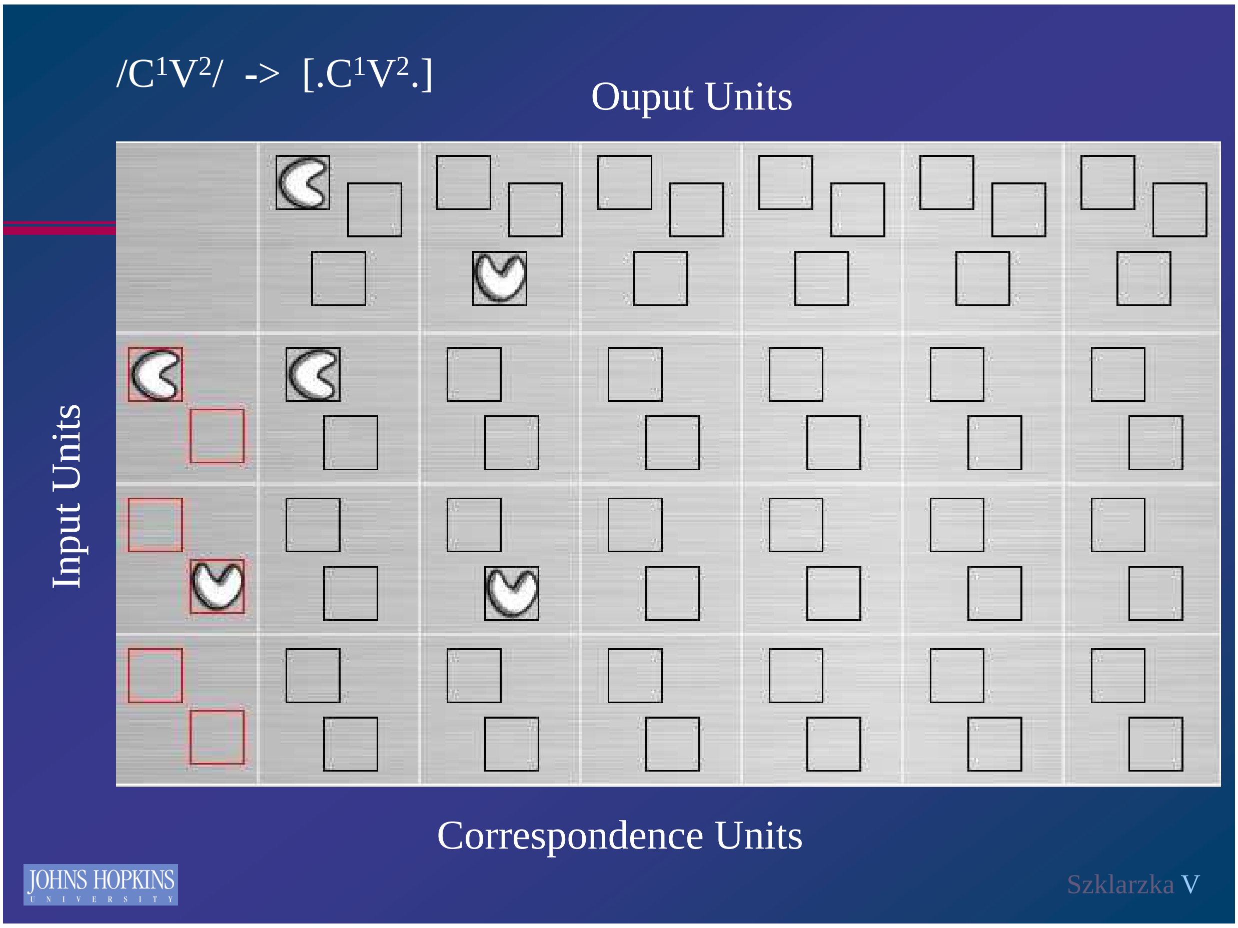
Codas not allowed.

/$C^1V^2C^3$/	[.C^1V^2.C^3V.]
/cat/	[.ca.tu.]

CV Net

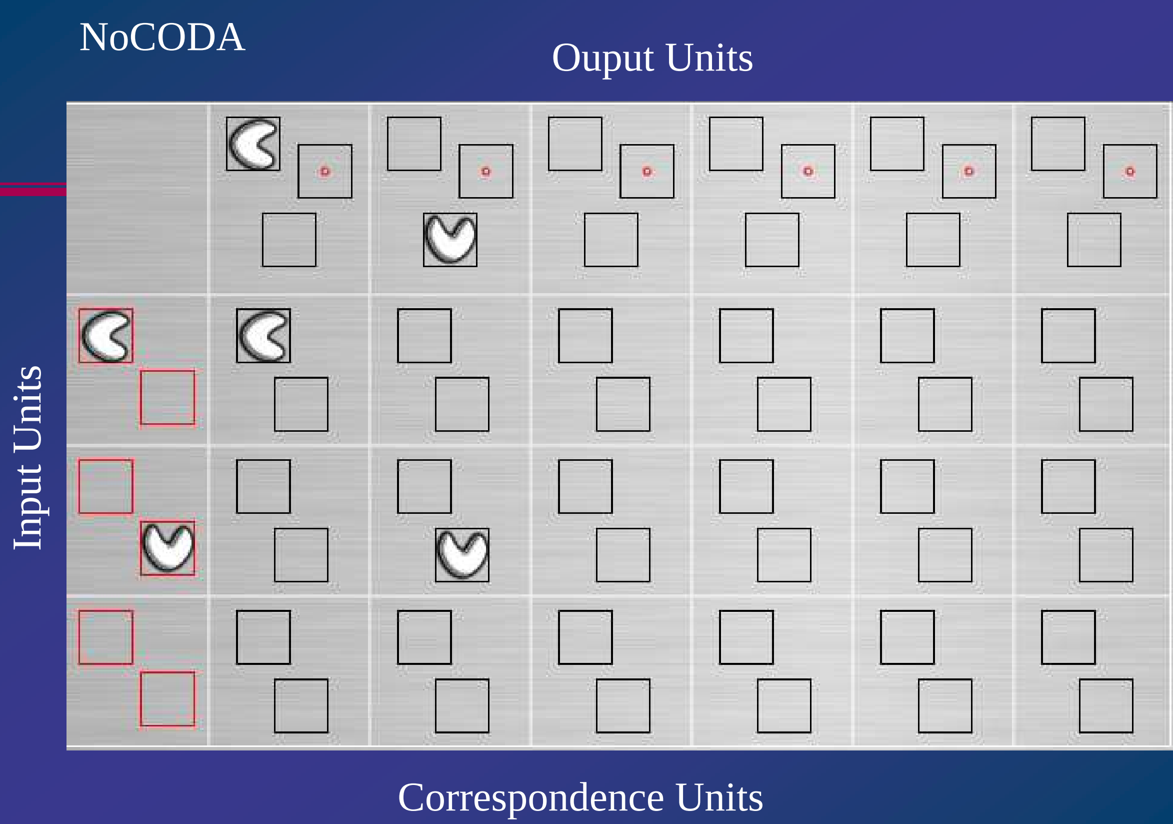
- Harmony network
  (Boltzman machine / Hopfield net)
- Localist representations
- Input units, output units, correspondence units
- No hidden units
- Each constraint is a set of (tied) symmetric weights + biases.


Ouput Units
Input Units
Correspondence Units
Szklarzka V


$/C^1V^2/$ -> $[.C^1V^2.]$
Ouput Units
Input Units
Correspondence Units
Szklarzka V

CV Net: Constraints

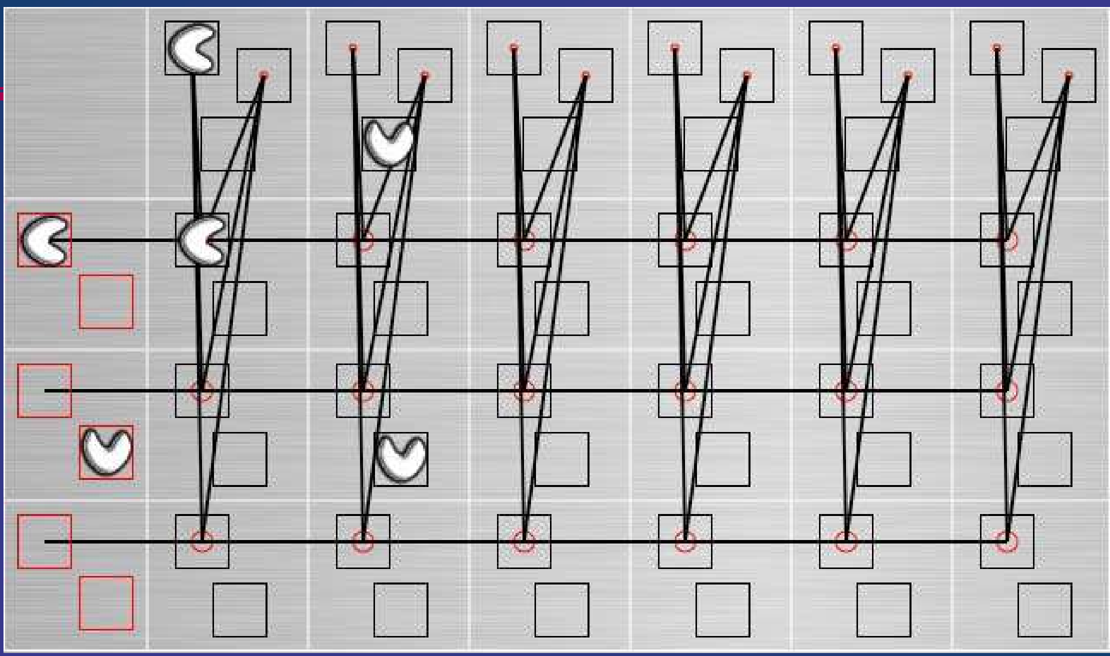
- Each constraint is a set of (tied) symmetric weights + biases.



FILLc

Ouput Units

Input Units



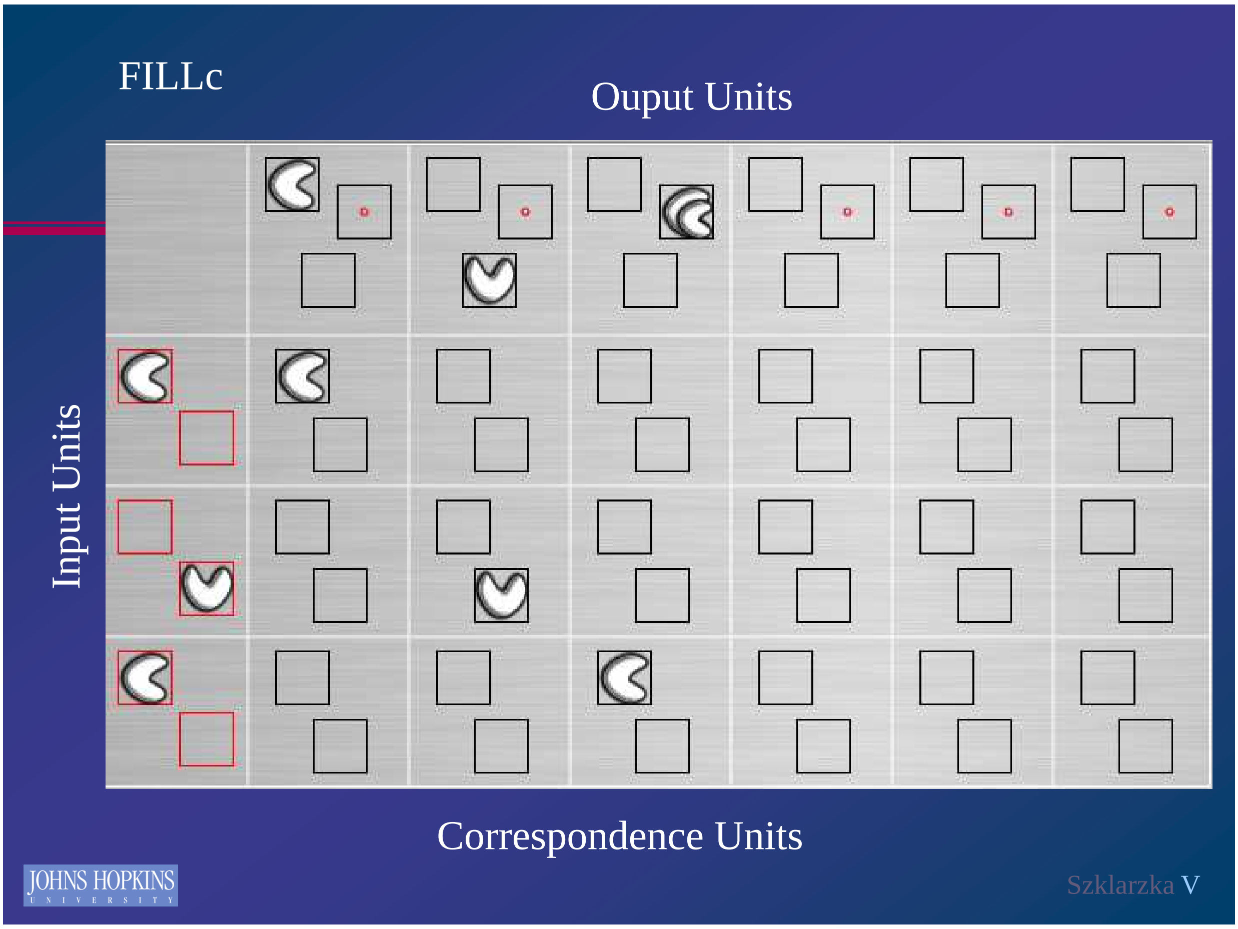
Correspondence Units

CV Net: Violations & Harmony

- Harmony is a measure of the extent to which a network state obeys the (local) constraints implied by a weight matrix.

$$H_i(a) = \tfrac{1}{2}\sum_{\varphi,\psi=1}^{N} c^{i}_{\varphi,\psi} a_\varphi a_\psi$$

- The number of violations of a constraint i correspond to the negative integer value of the harmony of the network w.r.t. that constraint H_i


FILLc
Ouput Units
Input Units
Correspondence Units
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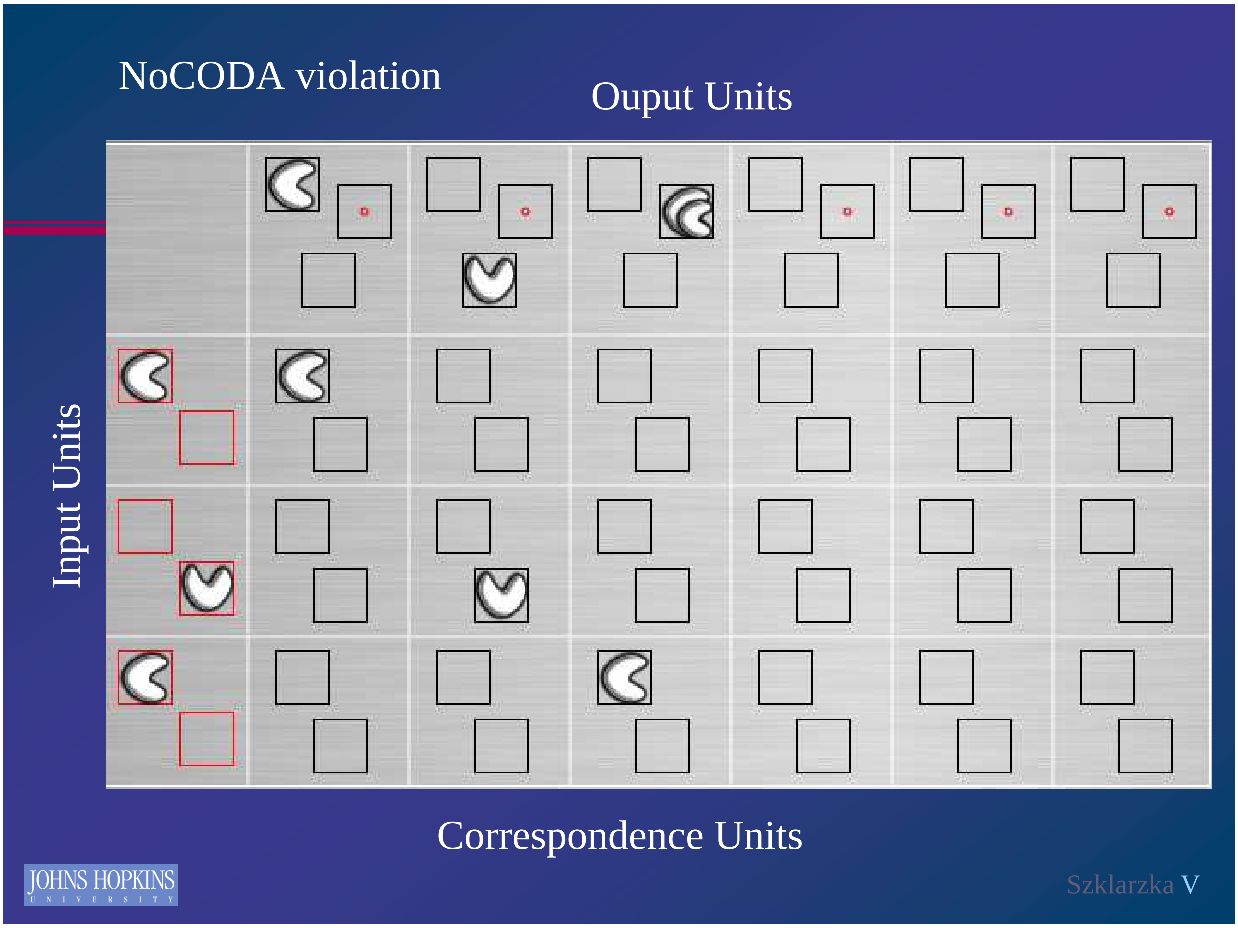
NoCODA violation
Ouput Units
Input Units
Correspondence Units
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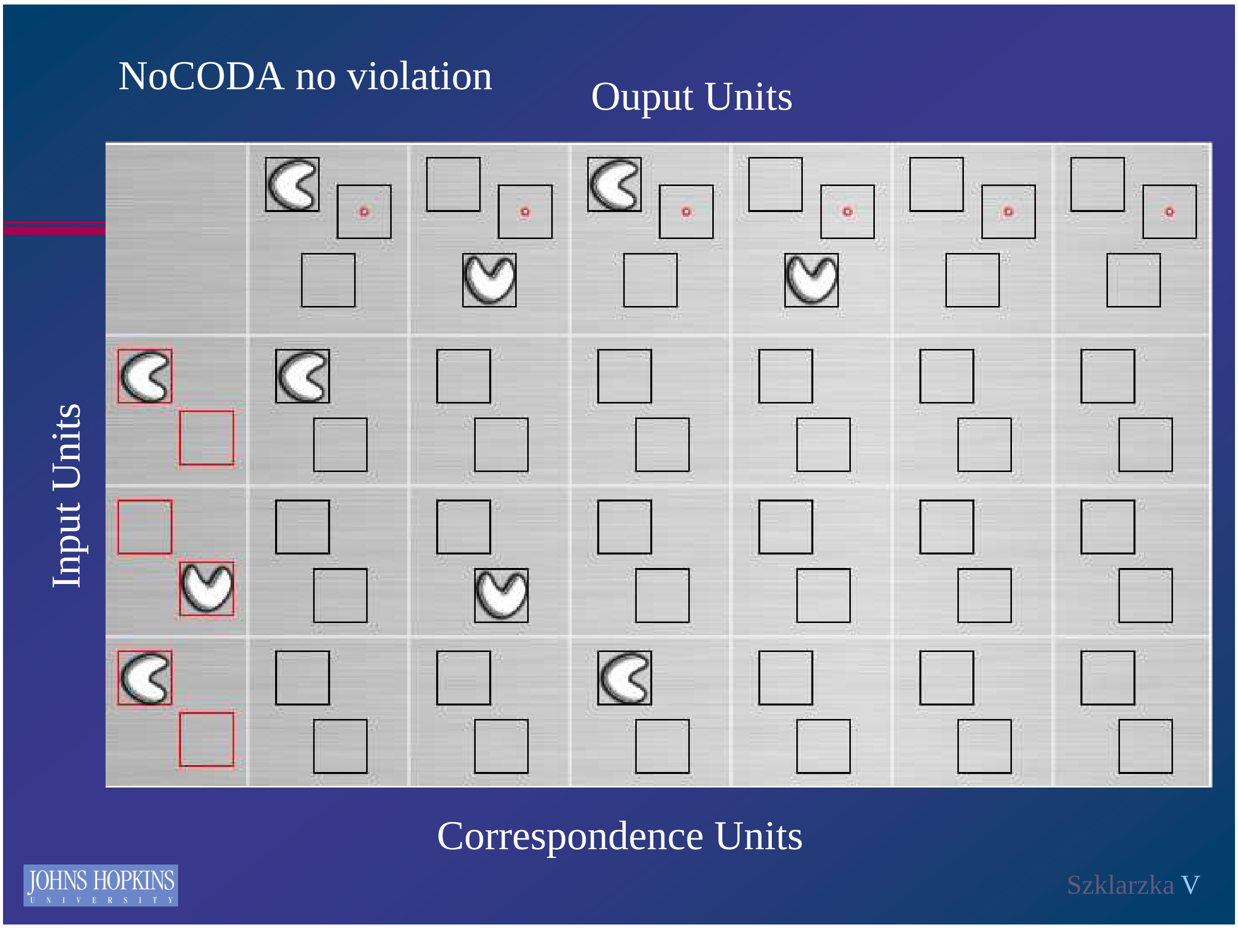
NoCODA no violation
Ouput Units
Input Units
Correspondence Units
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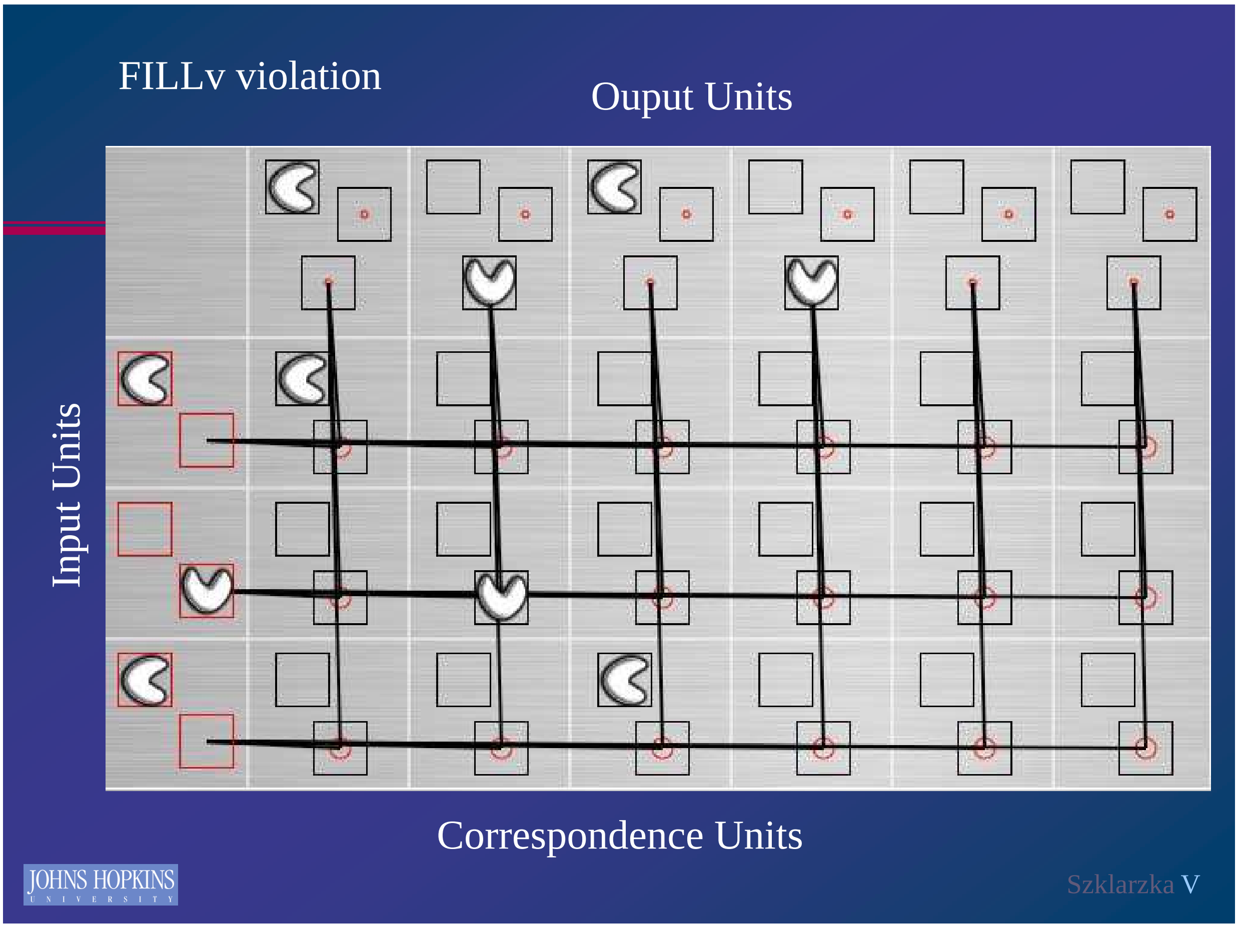
FILLv violation
Ouput Units
Input Units
Correspondence Units
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Szklarzka V

CV Net: Violations & Harmony

- The network activation state that yields the (global) maximum harmony value corresponds to the optimal candidate for a given input.

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CV Net: Strict Dominance

- For constraints A >> B, strict dominance implies that no matter how bad a candidate form is on B, if it is better than all other forms on A, it is optimal.
- Harmony is a real valued function.
- If the difference in harmony values across constraints is exponential, strict dominance obtains.
  - Must this be the case?

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CV Net: Processing

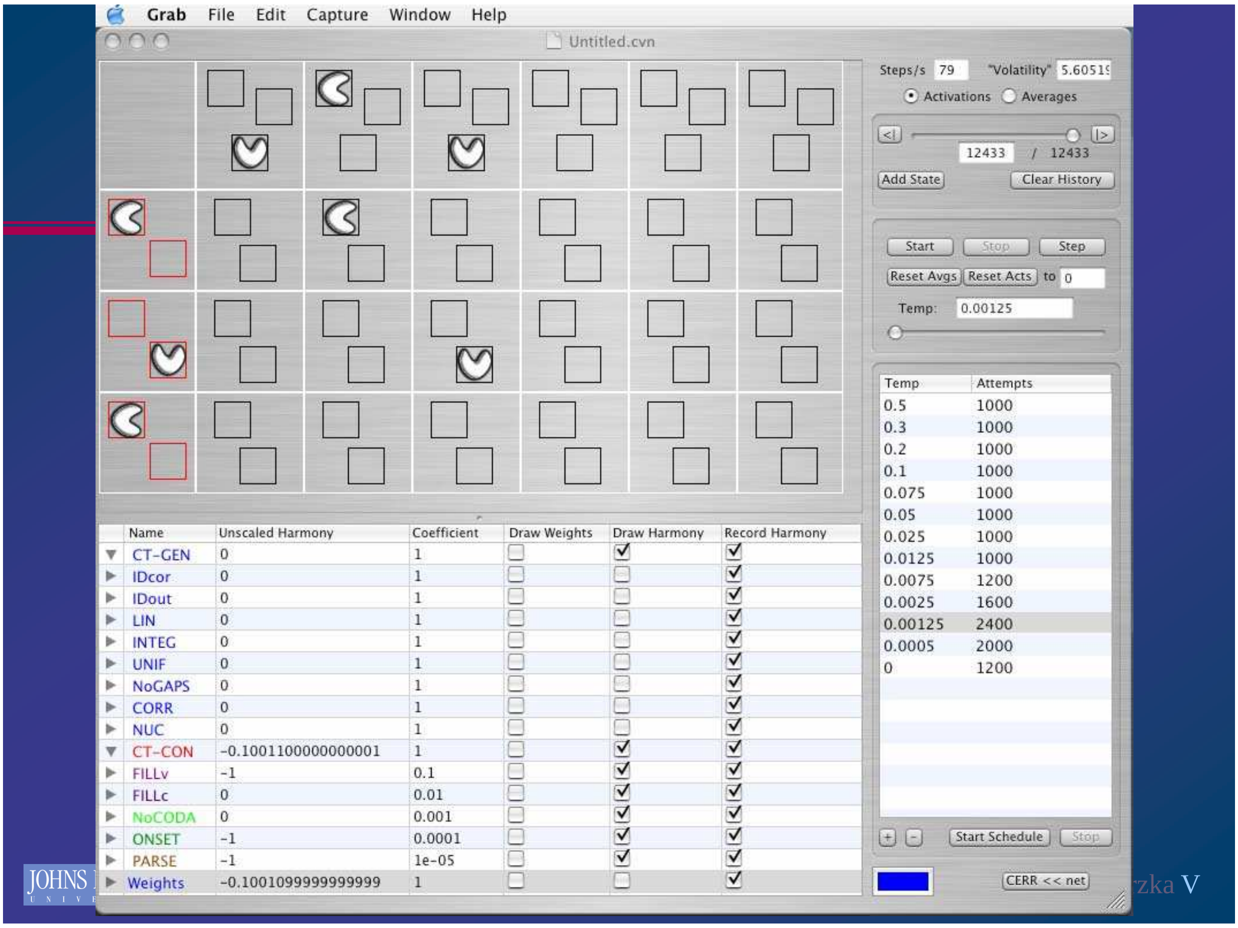
- Processing occurs as in an ordinary Boltzman machine -- through simulated annealing.
- Updates:
  - A unit is selected at random
  - If the net input to the unit + a random variable whose range depends on the “network temperature” is positive, the unit fires. Otherwise, it does not.
- This proceeds through stages where the temperature is gradually lowered.

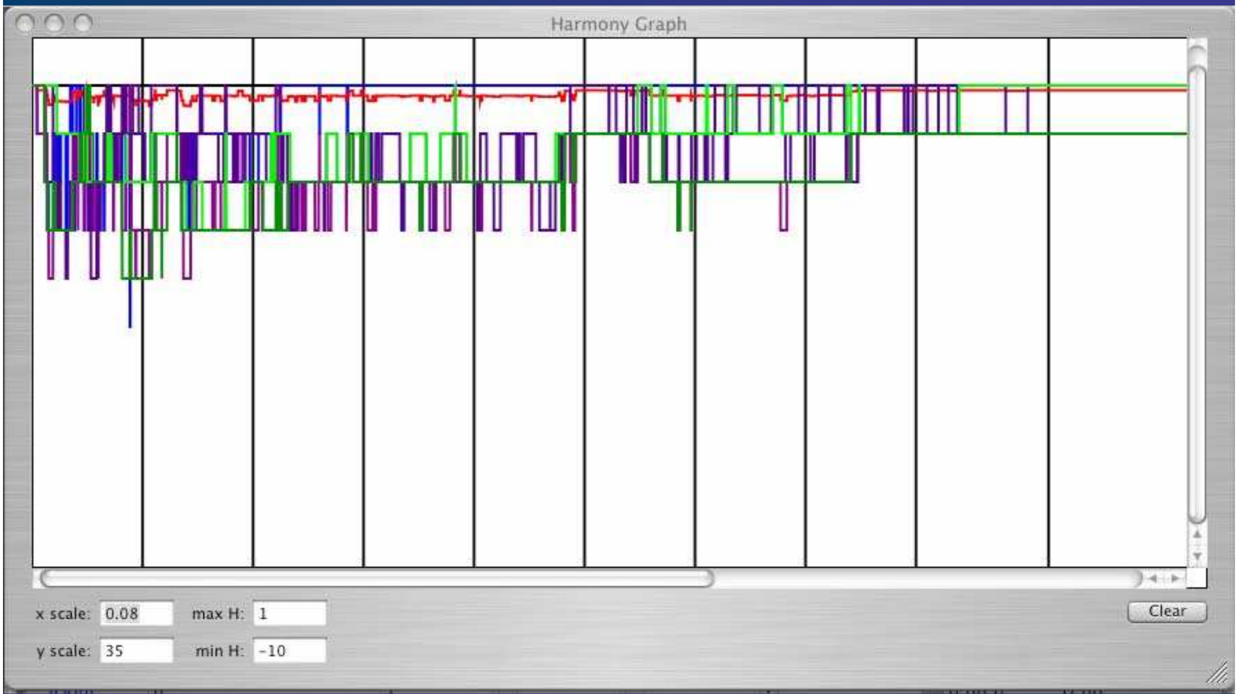
CV Net: Processing Problems

- Local Harmony maxima
- CON constraints are supposed to help the network choose the correct local maximum. (the global one).
- But the GEN constraints, high ranked, make it very difficult for the network to get from one GEN-respecting state to another.
- Even though the global harmony maximum is the optimal candidate, it is not necessarily easy for the network to find.
  - With these activation dynamics.

CV Net: Learning

- Boltzman Machine Learning Algorithm.
  - Calculate the network's best guess for a clamped input.
  - Compare to the correct output for a clamped input.
  - Adjust connection strengths to make the correct output more likely.
- Boltzman Machine Learning Algorithm w.r.t. Constraints (as sets of tied weights) as opposed to individual weights.
  - Corresponds to symbolic constraint demotion.
  - If the expected values of activations can be approximated.





Thank you

Outline and Program

- formal semantics
- dynamic semantics

≫ questions and answerhood

≫ information exchange

- conclusions

≫ please interrupt!

Questions in a Dynamic Perspective

Paul Dekker

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IKP, Bonn June 7, 2004

Satisfaction Semantics

- $M, g, \vec{e} \models \phi$

- models or situations
- variables or indices
- indefinites or pronouns

Classical Semantics

- meaning equals truth- or satisfaction-conditions
- knowing the meaning of an indicative sentence equals knowing the conditions under which it is true

- logico-philosophical tradition
- Frege, Russell, Wittgenstein, Tarski, Montague
- knowledge, truth, and inference
- distinguish between various possibilities

Dynamic Semantics

- the interpretation of utterances depends on the context of utterance
- and they are intended to change the context of utterance

(7) I lost a marble. It is probably under the sofa.
(8) It is probably under the sofa. I lost a marble.

(9) Mary's head was chopped off but even so it kept smiling.
(10) ?Mary was decapitated but even so it kept smiling.

Grice's Program

- combine logical semantics with pragmatic reasoning

(1) John switched off the light. He entered the room.
(2) John entered the room. He switched off the light.

(3) If everybody had a beer, everybody had one.
(4) If *someone* had a beer, everybody had one.

(5) You may have an apple or a pear.
(6) You may have an apple and you may have a pear.

Motivating Examples

(11) John has children, and all of his children are bald.

(12) All of John's children are bald and ?he has children.

(13) John married Jane and he regrets that he married her.

(14) John regrets that he married Jane and ?he married her.

(15) Your wife is now cheating on you, while you don't know it.
?And your wife is now cheating on you, while you don't know it.

(16) John left. Mary started to cry. (weak-hearted Mary ;-)

(17) Mary started to cry. John left. (hard-hearted John ;-)

Dynamic Issues

- anaphora
- presupposition
- epistemic modalities
- discourse relations
- questions and answers

Interrogative Semantics

- meaning equals answerhood-conditions
- knowing the meaning of an interrogative sentence equals knowing the conditions under which it is (fully) answered

- logico-philosophical tradition
- Hamblin, Karttunen, Groenendijk and Stokhof
- answerhood and question entailment
- distinguish between various *sets* of possibilities

Update Semantics

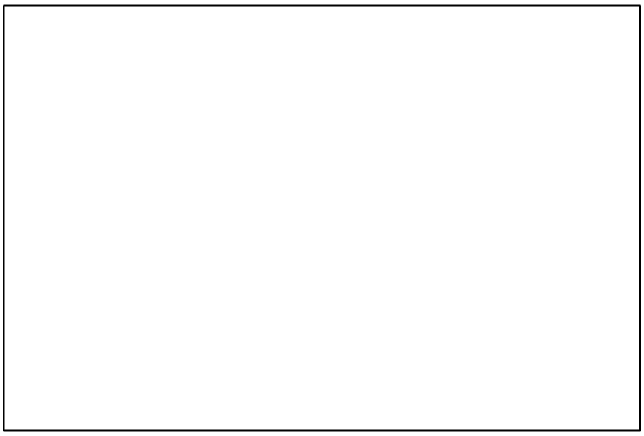
- the meaning of an indicative *utterance* resides in its update potential

- of what interlocutors believe to be the common ground

≫ of what interlocutors believe they commonly assume to be true

≫ of what interlocutors believe they commonly assume to be at issue

Logical Space



Nirvana: no assumptions, no needs

Indifference and Answerhood

- intensional models $\mathcal{M}$ so that $\mathcal{M}_w$ is an extensional model
- $[\![\phi]\!]_{\mathcal{M},g} = \{\vec{\alpha}w \mid \mathcal{M}_w, g, \vec{\alpha} \models \phi\}$ (content of ϕ)

  $D(S) = \{w \mid \exists\vec{\alpha}\colon \vec{\alpha}w \in S\}$ (data of S)

  $A(S) = \{\ \{w \mid \vec{\alpha}w \in S\}\ \mid \vec{\alpha}v \in S\}$ (p'ble answers)

  $I(S) = \{\langle v, w\rangle \mid \exists\vec{\alpha}\colon \vec{\alpha}v \in S \;\&\; \vec{\alpha}w \in S\}$ (indifference)

  $\phi \models_{\mathcal{M},g} \psi$ iff $I([\![\phi]\!]_{\mathcal{M},g}) \subseteq I([\![\psi]\!]_{\mathcal{M},g})$ (support)

≫ (pseudo-)partitions model the uncertainty (lack of data) and the worries (lack of indifference) of an agent

- the partition theory links logic with decision theory

Answerhood and Entailment

- $p \wedge q \models p$
  $\forall x Cx \models Ca$

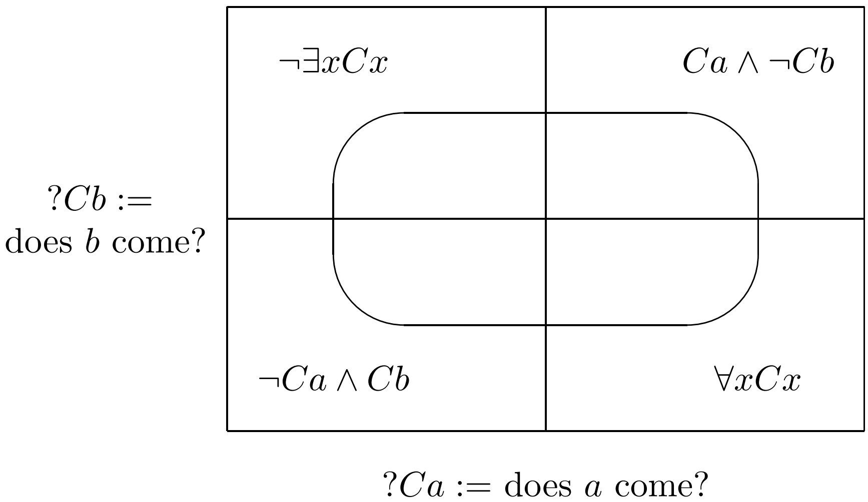
- $p \wedge q \models ?p$
  $\forall x Cx \models ?xCx$

- $?p \wedge ?q \models ?p$
  $?xCx \models ?Ca$

- $?p \models \top$

Pragmatic Space

- Will I go to the party? $?xCx :=$ who come?



Relevance and the Logic of Conversation

- Grice maxims for a rational and cooperative conversation
- quality, quantity, relation, manner
- a *general*, but not a *specific* assumption of rationality and cooperativity (it is based upon them, but not limited to them)
- a game of information exchange consists in trying to get one's own questions answered in a reliable and preferrably pleasant way

Update Semantics

- the meaning of an interrogative *utterance* resides in its update potential
- $S[\![\phi]\!]_{\mathcal{M},g} = \{\vec{\alpha}\vec{\epsilon}w \mid \vec{\epsilon}w \in S \ \& \ \mathcal{M}_w, g, \vec{\alpha} \models_{\vec{\epsilon}} \phi\}^*$
  $[T^* = \{\vec{\epsilon}w \mid \vec{\alpha}\vec{\epsilon}w \in T\}$ for the longest $\vec{\alpha}$: $D(T) = D(T^*)]$
- relevance taken from a global, not local, perspective

An Optimal Exchange

- $\sigma = \{\ \llbracket s \rrbracket \cap \llbracket \neg t \rrbracket\ ,\ \llbracket \neg s \rrbracket \cap \llbracket \neg t \rrbracket\ \}$
  $\tau = \{\ \llbracket s \rrbracket \cap \llbracket\ \ t \rrbracket\ ,\ \llbracket\ \ s \rrbracket \cap \llbracket \neg t \rrbracket\ \}$
  $CG_0 = W$

(18) *A:* Does Sue come? $CG_1 = \{iw \mid i = w(s)\}$

B: Yes. $CG_2 = \{iw \mid i = w(s) = \mathbf{1}\}^*$

$= \llbracket s \rrbracket$

Does Tim come? $CG_3 = \{iw \mid w \in \llbracket s \rrbracket \ \&\ i = w(t)\}$

A: No. $CG_4 = \{iw \mid w \in \llbracket s \rrbracket \ \&\ i = w(t) = \mathbf{0}\}^*$

$= \llbracket s \rrbracket \cap \llbracket \neg t \rrbracket = \sigma' = \tau'$

Optimal Inquiry

- given a set of interlocutors A with states $(\sigma)_{i \in A}$ a discourse $\Phi = \phi_1, \ldots, \phi_n$ is optimal iff:
  - $\forall i \in A$: $D(\llbracket \Phi \rrbracket) \cap D(\sigma_i) \models \sigma_i$ (relation)
    $\bigcap_{i \in A} D(\sigma_i) \models D(\llbracket \Phi \rrbracket)$ (quality)
    Φ is minimal (quantity)
    Φ is well-behaved (manner)
- with epistemic logical and decision-theoretic freedom
- we get informativity, non-redundancy, consistency, and congruence implicatures

Extensions (1): Subquestions

(19) *A:* Who were at the awards?
Who of the Bee Gees?
B: Robin and Barry but not Maurice. (*POP*)
A: Who of the Jackson Five?
C: Jackie, Jermain and Mike, but not Marlon and Tito. (*POP*)
A: Who of Kylie Minogue?
D: Kylie Minogue. (*POP*)
⋮
(*POP*)

- subquestions used to answer superquestions
- but they are invisible in partitions

Global Perspective

- relatively standard picture
  - pose questions you have
  - answer them to the best of your knowledge
  - question – answerhood relations
  - congruence
- our picture is much more general

Almost, but not Anything, Goes

(21) *A:* Will Arnold come?
B: Will you come?
A: Yes.
B: Then I don't know.
A: Oh, sorry, I am confused, I cannot come.
B: Then I still don't know about Arnold.

- that sounds pretty confused
- a nephew of Moore's paradox?

Extensions (2): Counterquestions

- 'side sequences' (Jefferson 1972, Clark 1996)

(20) *Waitress:* What'll ya have girls?
Customer: What's the soup of the day?
Waitress: Clam chowder.
Customer: I'll have a bowl of clam chowder and a salad with Russian dressing.

- discourse local versus epistemic global view

Conditional Questions (cont'd)

(24) *A:* Do you go to the party?
B: If I go to the party, will prof. Schmull be there?

- indeed B may not be interested in the question whether prof. Schmull comes if she doesn't come herself.

Extensions (3): Conditional Questions

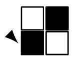
(22) *A:* If we throw a party tonight will you come?
B: Yes! (If you throw a party tonight I will come.)
B: No! (If you throw a party tonight I will not come.)
B: There will be no party.

(23) *A:* If it rains, who will come?
B: John and Mary but not Dick and Trix.
B: It won't rain.

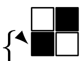
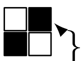
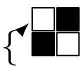
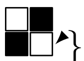
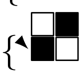
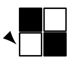
Superquestions (Cont'd)

- scenario: the party may be visited by me, and the professors Aims, Baker, Charms, Dipple, and Edmundson: $2^5 = 32$ possibilities
- since my decision depends on that of the others that reduces for me to $2^4 = 16$
- I prefer to speak to A and otherwise C, but I know that
  if B is there she will absorb A if B doesn't absorb C, that is, if C is not absorbed by D
  if neither B and C are present, D will absorb A
- if this ain't human, it is academic at least

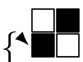
Extensions (4): Superquestions

- actual world:  (agent A is at $a1$)

. A and B's information and indifference is characterized as:

- $\sigma = \{ \{$  ,  $\}$, $\{$  ,  $\} \}$
  $\tau = \{ \{$  ,  $\} \}$

(25) *A:* Am I on a black square? *B:* I don't know. *A:* On which square am I? *B:* You're on $a1$. *POP A:* Then I am on a black square. *POP*

- result: $\sigma' = \tau' = \{ \{$  $\} \}$

Conclusions

- the Gricean program is still actual
- it extends beyond mere indicative utterances
- local compositional semantics for questions and answers
- in Gricean combination with a global, epistemic pragmatics

- we have presented only a program here
- understanding actual interpretation and choice of strategies requires much more work

Will I Go to the Party?

-

	$C\&D$	$C\&\neg D$	$\neg C\&D$	$\neg C\&\neg D$
$A\&\ B$	-	+	-	-
$A\&\neg B$	+	+	-	+
$\neg A\&\ B$	-	-	-	-
$\neg A\&\neg B$	-	+	-	-

(26) $(A\ AND\ [(\neg B\ AND\ (D \rightarrow C))\ OR\ (B\ AND\ C\ AND\ \neg D)])\ OR\ (C\ AND\ \neg B\ AND\ \neg D)$?

(27) Will I like the party?

(28) Who come?