Modality for the 21st Century (Slides).

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Modality for the 21st century

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Why not share questions?

Some are particularly talented for asking, some are specifically talented for answering. We tend to restlessly thrust *answers* upon our scientific community. But – more often than not – *questions* would have been even more welcome than *answers*. Why not share questions?

• Hubert Haider & Henk van Riemsdijk
Language & cognition

Reasoning about possibilities without language
Question

• Prelinguistic babies and crows can reason about possibilities.

• How does grammar recruit this ability for talk about possibilities?
Reasoning about Hidden Causes

A stick may come out through the opening in the hide. The stick would hurt the bird if he was trying to get food from the box. A person may go into the hide to move the stick, or the stick may move without a person in the hide.

A box with food that the bird can get out with a tool, but only from the side where he could potentially get hit by the stick. He can’t look at the hole in the hide while trying to get the food.
Hidden Agent Condition
The crow sees two humans walk into the cage. One enters the hide. One is standing in the corner. A stick is probed through the hole of the hide towards the baited box 15 times. Both humans leave the room.
If the crow could talk
The human must be moving the stick. It would hurt me if I tried to get the food. Once the human has left the hide and the room, it’s safe for me to probe for the bait in the box.
Unknown Agent Condition
The crow sees one human enter the cage and stand in the far corner, with closed eyes and hands held in front of the body. The stick was probed through the hole in the hide 15 times. The human then left.
If the crow could talk
I don’t know what is moving the stick. It’s not safe for me to try to probe for the bait in the box. I need to be cautious. The stick might come out and hit me.
Result

• Taylor et al. found a way to measure the degree of cautious behavior of the crows for the two conditions. They examined the number of times they inspected the hide and abandoned probing for food in the box.

• The crows inspected the hide and abandoned probing for food more often in the Unknown Agent Condition than in the Hidden Agent Condition.

Intuitions of probabilities shape expectations about the future at 12 months and beyond.

PNAS 104(48).

“We checked whether infants have expectations about future single events never before seen...”
The infants saw a movie with three yellow and one blue object bouncing in a container, simulating a lottery.
After an occlusion period, one of the objects exited, presenting an improbable outcome (b), or a probable outcome (d). Afterward, the occluder faded out and infants could see all of the objects.
If the infants could talk

(1) An outcome where the blue object exits is less likely than an outcome where a yellow object exits.

(2) There is only a 25% chance that the blue object will exit.
Possible versus impossible

Diagram showing multiple possibilities and impossibilities.
If the infants could talk

(1) The blue object can exit.
(2) The yellow objects cannot exit.
“Together, these experiments show that just as infants expect that future events will respect physical constraints they also expect that in the future the most likely outcome will occur.”
Mapping possibilities

The core cognitive ability
The possibilities considered preserve general properties of the actual world, like the laws of nature.
Ranking

• Possibilities are ranked.

• Likelihood is a possible basis for ranking.
Factual domain projection

- Possibilities are projected from actual individuals or situations: they contain counterparts of those situations.

- The crows and the babies project possible ‘continuations’ of actually experienced situations.
seen part of the world
now
Modal anchors

The actual individuals or situations that possibilities are projected from are the modal anchors: Hacquard 2006.
Modality & the language faculty

Questions
A semantic representation

• The blue object can exit.

\[ \exists e \ (\text{now}(s_0)(e) \land \exists w \ (w \in \text{f}_{\text{factual}}(e) \land \exists e' \ (e' \leq_{\text{part}} w \land \text{later}(e)(e') \land \text{exit}(\text{the-blue-object})(e'))) ) \]

• A domain projection variable recruits the ability to project possible ‘continuations’ from a designated part of the actual world.
A technology that interacts with other cognitive resources
Questions

• Does the language faculty provide the logical parts of semantic representations?

• Variables? Logical symbols: binders, quantifiers, connectives? The predicate-argument relation?
Logic in Grammar

“This book investigates the relation between language and logic. ... The characterization of grammatical structure requires a more direct role of logical inferences.”
Question

• Where do the non-logical parts of semantic representations come from?
Non-logical building blocks

• The blue object can exit.

\[ \exists e \ (\text{now}(s_0)(e) \land \exists w \ (w \in f_{\text{factual}}(e) \land \exists e' \ (e' \leq_{\text{part}} w \land \text{later}(e)(e') \land \text{exit}(\text{the-blue-object})(e')))) \]
From non-linguistic cognition?

- Object and event individuation
- Agency
  - Possession
  - Causation
- Laws versus contingent facts
  - Modal domain projection
  - Ranking of possibilities
Semantic representations

• Assign correct truth-conditional contribution.

• Provide a plausible interface with morphosyntax.

• Provide a plausible interface with other systems of cognition.
The Grammar-Cognition Manifesto

Every semantic analysis should carry a commitment to a plausible division of labor between the contributions of grammar and those of other systems of cognition.
Beginning modality

Adjectives versus auxiliaries
Adjectives versus auxiliaries

(1) a. This glass is breakable.
    b. This glass can break.

(2) a. This glass is fragile.
    b. This glass can break easily.
David Lewis’ sorcerer

“A sorcerer takes a liking to a fragile glass, one that is a perfect intrinsic duplicate of all the other fragile glasses off the same production line. He does nothing at all to change the dispositional character of his glass. He only watches and waits, resolved that if ever his glass is struck, then, quick as a flash, he will cast a spell that changes the glass, renders it no longer fragile, and thereby aborts the process of breaking.”

Different truth-conditions

(1) a. This glass is fragile.
    b. This glass can break easily.

• 1(a) is true on Lewis’ scenario; 1(b) has an interpretation where it is false.
Factual domain projection

(1) a. This glass is fragile.

• The modal anchor is the glass. The modal alternatives all have counterparts of the glass, but may vary otherwise. In particular, they may vary with respect to the circumstances the glass finds itself in: there may or may not be a sorcerer.
Factual domain projection

(1) b. This glass can break (easily).

- The modal anchor is the glass plus relevant circumstances. The modal alternatives all have duplicates of the glass plus those circumstances. With Lewis’ scenario, there is a strong pull to include the sorcerer and his urge to protect the glass in the relevant circumstances.
Vulnerability

(2) You: This glass can’t break. It is protected.
Me: What if the sorcerer dropped dead?

- The modal domain can always be widened by shrinking the anchor – by leaving out more and more of the outside circumstances.

- Existential claims get weaker, and their negations stronger, with domain widening.
“Suppose I am talking with some elected official about the ways he might deal with an embarrassment. So far, we have been ignoring those possibilities that would be political suicide for him. He says: “You see, I must either destroy the evidence or else claim that I did it to stop Communism. What else can I do?” I rudely reply: “There is one other possibility – you can put the public interest first for once!” ”

- Lewis: Scorekeeping in a Language Game.
Pushing modal boundaries

Political survival.
Destroy evidence, claim false motives

Political suicide. Put public interest first
Question

Where does the shiftability of modal domains come from?
Negotiating possibilities

No special dependence on modal words
An old riddle

Two boys were born on the same day, in the same year, to the same mother, but they were not twins. How can this be?
Triplets, quadruplets, ...
Eliminating possibilities

Narrow interpretation

etc.

Minimal interpretation: two boys and no other children were born.

triplets

Broad interpretation, determined by grammar
Law of Exhaustivity

• Oswald Ducrot: speakers are expected to provide the strongest piece of information they have that is relevant to the topic and likely to be of interest to the addressee.

• John McCarthy’s circumscription.

• Paul Grice, of course.
Thinking too fast?

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

100 minutes?

5 minutes?
5 machines, 5 minutes, 5 widgets

- 100 widgets in 5 minutes.
5 machines, 5 widgets, 5 minutes

1st minute  M1 → W1
2nd minute  M2 → W2
3rd minute  M3 → W3
4th minute  M4 → W4
5th minute  M5 → W5

• 100 widgets in 100 minutes.
Incompatible interpretations

Narrow interpretation via world knowledge.

5 minutes

100 minutes

Broad interpretation

Narrow interpretation via world knowledge.
Eliminating possibilities

• Grammar determines broad interpretations.

• Narrow interpretations come from interactions with non-linguistic knowledge resources: presumptions about cooperative interaction, presumptions about the normal course of events, etc.
Grammar wins

- Narrow interpretations can always be challenged.

- Broad interpretations can always be pushed for.
Back to modal expressions

Where do modal anchors come from?
Question

• Modal auxiliaries and modal adjectives take different kinds of modal anchors. What determines the anchor for a modal expression?
• Anchors for modal expressions are routinely provided in the course of a syntactic representation.
The Modal Anchor Conjecture

• The anchor of a modal expression is one of its arguments.

• Obvious for modal adjectives like *fragile*, but what about *can*?
Ability *can* as a raising verb

• Martin Hackl 1998. On the semantics of ability attributions. Manuscript, MIT.

• Ability *can* projects a raising structure.

• But then any kind of *can* projects a raising structure.
An ambiguity

• A lot of people can jump in this pool. (Hackl 1999).

• [this pool\(\lambda_n [can [\text{vP everyone jump in } x_n]]\]

• [everyone\(\lambda_n [can [\text{vP } x_n \text{ jump in this pool}]]\]

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Raising

• \([\text{The glass} \lambda_n [\text{can} [vp t_n \text{ break} ] ] ]\]

• \([[\text{can}]\] =
  \(\lambda s \lambda p \exists w \ (w \in f_{\text{factual}}(s) \ \& \ \exists s'(s' \leq_{\text{part}} w \ \& p(s')))\)\)
Anchors for modal auxiliaries

• The anchor for *can* must be its situation argument.

• Situations are poorly individuated. There is thus a certain amount of indeterminacy about the modal domain for *can*.
Impact of syntactic category

Gradability
Question

Which properties of modal expressions are determined by the properties of the syntactic categories they belong to?
Adjectives versus auxiliaries

• Differences in argument structure lead to differences with respect to modal anchors.

• Differences with respect to gradability?
Gradability: adjectives

a. Her moving to Paris is more likely than his leaving Rome (is).
b. Her moving to Paris is more likely than you think (it is).
c. His leaving Rome is more desirable than (it is) feasible.
Gradability: auxiliaries

a. Jockl kann eher in Aufhausen gewesen sein, als Jackl in Mindelheim.
Jockl can more in Aufhausen been be
than Jackl in Mindelheim.

Jockl is more likely to have been in Aufhausen than Jackl in Mindelheim.
Gradability: auxiliaries

b. Jockl kann den Mord eher begangen haben als der Richter denkt.

Jockl can the murder more committed have than the judge thinks.

Jockl is more likely to have committed the murder than the judge thinks.
Gradability: auxiliaries

c. Jockl wollte diesen Mord eher begehen. Jockl wanted this murder more commit
als er konnte. than he could.

* Jockl was more desirous than capable of committing this murder.
In the best of all possible worlds

We should be able to predict the semantic properties and the typology of modals from the general properties of quantification (including degree quantification), the general properties of modal domain projection functions, and the general properties of syntactic categories.
A second mode of domain projection

Anchors with intentional content
Witness testimonies

(1) According to the testimony, the thief supposedly entered through the window.

(2) Given the testimony, the thief must have entered through the window.
Witness testimonies

(1) According to the testimony, the thief supposedly entered through the window, but we all know that the witness was lying.

(2) Given the testimony, the thief must have entered through the window, # but we all know that the witness was lying.
Reportative evidentials

(3) Dem Zeugen nach soll der Dieb
The witness after SOLL the thief

durch’s Fenster gekommen sein.
through+the window come be.

• ‘According to the witness, the thief is said to have entered through the window.’
Reportative mood

(4) Dem Zeugen nach sei der Dieb
The witness after be-SUBJ the thief
durch’s Fenster gekommen.
through+the window come.

• ‘According to the witness, the thief entered through the window.’
Domain projection: content mode

- Domain projection in the content mode requires anchors that can be naturally associated with intentional content. The projected modal alternatives are the worlds that are not excluded by the content of the anchor.

Question

• Are all types of intentional domain projection uniquely human?
The meaning of a reportative evidential

- $[[	ext{sole}]]) = \lambda p \lambda s \ \forall w \ (w \in f_{\text{content}}(s) \rightarrow \exists s'(s' \leq_{\text{part}} w \ \& \ p(s')))$

- Only defined for anchors corresponding to hearsay, rumors, legends, and some such.
Building speech reports from scratch

The action is in the subordinate clause
A manner of speaking

(1) Ralph tobte, dass man ihn nicht
Ralph raged that they him not
informiert habe.
informed have.SUBJ.

‘Ralph raged that they hadn’t informed him.’
(2) Ralph seufzte, dass er betrogen worden sei.
Ralph sighed that he betrayed been

‘Ralph sighed that he had been betrayed.’
Verbs of manner of speaking

- Babble, bark, bawl, bellow, bleat, boom, bray, burble, cackl, call, carol, chant, chatter, chirp, cluck, coo, croak, croon, crow, cry, drawl, drone, gabble, gibber, groan, growl, grumble, grunt, hiss, holler, howl ...

- Complete list in Levin 1993.
Conclusions

• Sentential complements do not necessarily relate to any argument of the embedding verb.

• *That*-clauses all by themselves seem to be responsible for creating reports on the content of attitudes and speech events.
Retrieving content

Embedded reportative modals
Origin of complementizers

• In many unrelated languages, complementizers developed from verba dicendi.
Dravidian complementizers

<table>
<thead>
<tr>
<th>All derived from verba dicendi</th>
<th>Bayer 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telugu</td>
<td>ani</td>
</tr>
<tr>
<td>Tamil</td>
<td>endru</td>
</tr>
<tr>
<td>Kannada</td>
<td>anta</td>
</tr>
<tr>
<td>Malayalam</td>
<td>enne</td>
</tr>
</tbody>
</table>
Indo-Aryan final complementizers

<table>
<thead>
<tr>
<th>All derived from ‘say’</th>
<th>Bayer 1999</th>
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</thead>
<tbody>
<tr>
<td>Bengali</td>
<td>bole</td>
</tr>
<tr>
<td>Oriya</td>
<td>boli</td>
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<td>Assamese</td>
<td>buli</td>
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<tr>
<td>Marathi</td>
<td>mhanun</td>
</tr>
<tr>
<td>Dakhkhini-Hindi</td>
<td>bolke</td>
</tr>
</tbody>
</table>
Event identification

Ralph sighed

[say] Ortcutt was a traitor.

The embedding verb describes events of sighing.

The subordinate clause is headed by a modal feature [say] and describes speech events or mental states that carry the information that Ortcutt was a traitor.
A reportative modal

• $[[ [\text{say} ] ]] = \lambda p \lambda e \ \forall w \ (w \in f_{\text{content}}(e) \rightarrow \exists s (s \leq w \& p(s)))$

Anchor argument

Projecting modal domains from anchors
Composition

• \[[\text{sigh}]\] = \(\lambda e \text{sighing}(e)\)

• \[[\text{[say] Ortcutt was a traitor}]\] =
  \(\lambda e \forall w (w \in f_{\text{content}}(e) \rightarrow \exists s (s \leq w \& \text{traitor(Ortcutt)}(s)))\)

• \(\lambda e (\text{sighing}(e) \& \forall w (w \in f_{\text{content}}(e) \rightarrow \exists s (s \leq w \& \text{traitor(Ortcutt)}(s))))\)
Ralph believes [say] Ortcutt is a traitor.

The embedding verb describes states of belief.

The subordinate clause is headed by the modal feature [say] and describes speech events or mental states that carry the information that Ortcutt was a traitor.
Subcategorized argument

• \([[[\text{believe}]]] = \lambda p \lambda e \ (\text{belief}(e) \ & \ p(e))\)

• \([[ \ [\text{say} \ \text{Ortcutt is a traitor}]]] = \lambda e \ \forall w \ (w \in f_{\text{content}}(e) \rightarrow \exists s(s \leq w \ & \ \text{traitor(Ortcutt)(s)}))\)

• \(\lambda e (\text{belief}(e) \ & \ \forall w \ (w \in f_{\text{content}}(e) \rightarrow \exists s(s \leq w \ & \ \text{traitor(Ortcutt)(s)})))\)
Extraction differences

(1) * Who did Ralph sigh that he saw at the beach?

(2) Who did Ralph believe that he saw at the beach?

Question

• Does complementation generally amount to conjunction of properties of events/situations?

• Are modals in the left periphery generally the glue that makes complementation possible in natural languages?
The big issues

Language & cognition in the area of modality
Recruitment of basic cognitive abilities

• Are modal domains generally projected from arguments of modal expressions?

• Are there just two types of modal domain projection: factual and content related?
Logic and grammar

Is the logical vocabulary of semantic representations provided by the language faculty?
Properties of syntactic categories

Different syntactic categories form different types of modal comparatives. What exactly are the differences between modal and adjectival comparatives?
The semantics of embedding

I conjectured that all embedding structures are conjunctive and are made possible by modal elements in the left periphery of the embedded complements. The modal semantics of those constructions does not come from the embedding verb.
The end

Thank you!