Computational Approaches to Metaphor Interpretation: Some Considerations arising from a Deep Reasoning System

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Plan of Talk

- Branches of my work
- Characteristics of *ATT-Meta* approach and system
- Implications for large-scale metaphor processing
- Conclusions

Branches of my Work

- *ATT-Meta approach/system*
  for reasoning needed for open-ended non-conventional metaphor

- *metaphor & affect*
  - in ATT-Meta
  - in a practical, conversational-agent context (E-Drama project)
  - in theoretical work below

- *links with metonymy, simile, hyperbole, irony* [theoretical]

- *links with reasoning about mental states* [implementational/theoretical]

- *metaphor generation* [NEW: starting in July; EU grant]

ATT-Meta and Mappings

- I assume with others that many lexical terms have lexiconized metaphorical meanings. But otherwise ...

- **ATT-Meta is mapping-based, with a small number of already-known, highly general mappings for each of a range of metaphorical views (roughly, conceptual metaphors).**

  DISEASE AS POSSESSED OBJECT
  being infected by disease D $\longleftrightarrow$ *possessing object D*

  IDEAS AS PHYSICAL OBJECTS
  mental usage of idea J $\longleftrightarrow$ *physical operation on physical object J*

  MIND AS CONTAINING INNER COMMUNITY of PERSONS
  believing X to be evidenced $\longleftrightarrow$ *some inner person believing X to be evidenced*

- **View-Neutral Mapping Adjuncts** (VNMAs)

- ((**Novel mappings:** not implemented in system, but compatible with the general approach.))

Emphasis on Map-Transcending Metaphor

Map-Transcending= resting on one or more metaphorical views but going beyond the specific mappings available for those views

"Within the deepest recesses of our mind, lies a fear that sharks will attack us."

"Perhaps a part of my mother's mind she did not know about was making sure she got pregnant then."

"A small voice inside Mary was insisting that Mick was adorable."

"My car thinks it is on holiday."

"The managers were getting cricks in their necks from talking up [to some people] and down [to others]."

"Can you look at your own life, kind of on a continuum? Look down the road ... and see what that's gonna do... in your life?"

"I don't think strings are attached. If there are any they're made of nylon." (based, say, on CONSTRAINT AS ATTACHED STRINGS)

Internal-Insistence Example

"A voice inside Mary was insisting that Mick was adorable."

- One major connotation:

  While some aspect of Mary's thinking supported the idea that Mick was adorable, some other aspect contradicted this.

Inferential Connection to Mappings

- A source-side scenario is constructed within a PRETENCE environment.
  In this scenario:
  - Mary contains an inner community of persons.
  - The mentioned voice belongs to a person in that community.
  - This person believes that Mick is adorable.
  - There is also another inner person of Mary engaged in a conversation with the first one.
  - The first inner person is insisting that Mick is adorable, and believes this.
  - The second inner person has said something that contradicts this (hence the need for the first inner person to insist). The second inner person believes that Mick is not adorable.
- This scenario is derived from

  ancillary assumptions embodying familiarity with the metaphorical idea of a person containing a (usually small) community of people

  within-pretence, within-source-scenario inferences about real conversations and mental states of conversants.

Inferential Connection to Mappings, contd

The only *mapping* needed is

IF (IN REALITY) P is a person
AND (IN THE PRETENCE) C is a community of people
AND C is physically-in P
THEN {presumably}

(IN PRETENCE) some member of C believing X is at least evidenced

corresponds to

(IN REALITY) P believing X is at least evidenced

When the correspondence is created, it is used to infer (from the first inner person) that Mary believes there is evidence that Mick IS adorable and (from the second inner person) that Mary believes that there is evidence that Mick is NOT adorable.

The IF part serves as a set of *guards* that, intuitively, detect the presence of the view of MIND AS CONTAINING INNER COMMUNITY of PERSONS.

Ancillary Assumptions

The system can use rules called *ancillary assumptions* concerning the view of MIND AS CONTAINING INNER COMMUNITY of PERSONS.

Two are:

IF (IN REALITY) P is a person
AND (IN THE PRETENCE) Q is a person
AND Q is physically-in P
THEN {presumably}
(IN PRETENCE) P has an inner community.

IF (IN REALITY) P is a person
AND (IN THE PRETENCE) P has an inner community
AND (IN THE PRETENCE) Q is a person
AND Q is physically-in P
THEN {presumably}
(IN PRETENCE) Q is in P's inner community.

Two Conversation Rules

[belongs to reality; can be used in any space]

IF P is a person
AND P says that Z in a positive manner

THEN {presumably}

P believes that Z presumably holds.

[belongs to reality; can be used in any space]

IF P is a person AND L is P's interlocutor
AND P says that Z insistingly

THEN {presumably}

L says NOT-Z in a positive manner.

Lazy Car

"John's car is on holiday."

[simplification of an example implemented in system]

cf. "Your car is on holiday too!" seen on a hotel website.

- Within-pretence reasoning:

Because the car is on holiday, it is a person.

Because the person(/car) is on holiday, she[/he/its] is not going to work.

Because she is not at work, she is *persistently not doing her normal function.*

Lazy Car, contd.

- Assume mappings:

  IF [pretend] entity X corresponds to [real] entity Y
  THEN {presumably}
  [pretend] *doing-normal-function*(X) corresponds to [real] *doing-normal-function*(Y).

  IF [pretend] episode E corresponds to [real] episode F
  THEN {presumably}
  [pretend] COMPLEMENT-E corresponds to [real] COMPLEMENT-F.

  IF [pretend] activity A corresponds to [real] activity B
  THEN {presumably}
  [pretend] *time-aspect*(A,T) corresponds to [real] *time-aspect*(B,T).

- Then can infer that in reality the car is *persistently not doing its normal function.*

  (NB: "Agent" is used in very general sense, not a cognition-implying sense.)

Lazy Contemplative Car

"John's car thinks it's on holiday."

[implemented in system]

Real-discourse examples of cars' cognitive powers:

"the rpm's start to drop and the car acts like it wants to die"

"I thought that B0189 and B2646 may have something to do with why the car believes it should have the headlights on in the daytime."

- Within-pretence reasoning much as above, except that:

Because the car thinks she's on holiday, she thinks she is not required to go to work. [Simulative reasoning within the car's belief space.]

Because the car thinks she is not required to go to work then (by default) she is not going to work.

View-Neutral Mapping Adjuncts

- The above mappings of normal functions, abilities and complements are *view-neutral mapping adjuncts* (VNMAs).

- They do not rely on any specific metaphorical view.

- A VNMA is parasitic on existence of one or more suitable correspondences, and uses them to construct a new correspondence.

Focus of (Other) VNMAs

- Degrees (of holding of situations).
- Time relationships between situations, durations of situations, and rates of process-like situations.
- Aspectual shape of situations: persistence, termination, intermittency, gradualness, etc.
- Change relationships between situations.
- Causation, enablement/prevention, helping, ability, attempting.
- Modality, such as ought-to, required-to, etc.
- Mental/emotional states and value judgments (both of the understander and of agents within situations).
- Logical structure (not just negation).
- Choice.
- Qualitative set size.

Power of VNMAs

Through examination of many examples, I have found that ...

- The *point* of many metaphors is about

  normal functioning, ability/enablement/causation, affect, mental states, time-course, ...

- Many metaphors transfer their most important or even all information via VNMAs, not via view-specific mappings:

  view-specific mappings often merely form a matrix on which the VNMAs can work.

Pretence/Reality (Source/Target) Non-Parallelism

- Voice inside Mary insisting: no parallel in reality is assumed for the "voice," the "insisting" or the implied inner persons of Mary.

  They're merely mental tools towards that meaning, via highly general view-specific mappings and VNMAs.

  There is no need to have, and it could be difficult to construct, mappings for them.

  Car examples: the holiday state itself and the thinking have no parallels.

  Neck-crick: no parallels for the neck cricks, resulting pain, difficulty in turning heads.

- Non-parallelism well-recognized in the idiom literature [notably by Langlotz, 2006], and perhaps implicit in Relevance Theory [e.g., Carston & Wearing, 2011] etc., but not so much in the metaphor literature that rests on mappings.

Non-Parallelism, contd

- It's source scenarios as *wholes* that are important, rather than every component of them or every discourse element that contributes to the scenario.

- It's a mistake to think that the task of metaphor understanding is to translate each metaphorical bit of a discourse into target-side terms.

- The issue becomes yet more important with larger chunks of discourse. Various sentences may contribute to a source scenario. Whole sentences can lack a parallel: *Not every metaphorical sentence has a usefully separable meaning of its own in target terms.*

Non-Parallelism, contd

- *"Everyone is a moon, and has a dark side which he never shows to anybody."* [Mark Twain]

  A possible variant:

- *"Everyone is a moon. Everyone has a dark side which he never shows to anybody."*

- The clause/sentence "Everyone is a moon" does not (need to) be given its own target-side meaning.

- Rather, it conspires with the other clause/sentence to convey an overall source-side scenario.

- Indeed, the moon clause/sentence really just consolidates the info from the other segment. [Or would do if it were astronomically accurate! "Dark" should be "back" or something.]

- The moon clause/sentence is difficult to interpret in isolation.

Implications for Large-Scale Metaphorical NLP

- Use of complex, open-ended inference, involving uncertainty-management and vagueness-management: won't large-scale metaphor processing need it, to get effects similar to ATT-Meta's?

- Inference is needed even for fairly basic applications of MIND AS CONTAINING INNER COMMUNITY of PERSONS.

  Mental-state based reasoning can be needed in personifications as in

  > "My car thinks it's on holiday"
  >
  > "Cortisol doesn't know whether [the stress is bodily or mental]."
  > [heard on an advertisement on a website]

Implications, contd

- But: Downplaying of detailed view-specific mappings in favour of source-side inference and VNMAs:

  a helpful feature for large-scale application.

Reduces amount of mapping knowledge needed; more reliance on source-side knowledge and inference that an intelligent agent operating in the common-sense world needs anyway.

Of course this advantage may be reduced if the system is meant to be just a specialized piece of language technology.

Implications, contd

- Non-parallelism: helpful ...

  in reducing the number of individual metaphorical segments that need translation into target terms.

  in shifting pragmatic inference (including coherence-finding) more into source side, where it may be easier.

  But: don't yet know how to divide effort between source-side coherence finding and target-side coherence finding.

Implications, contd

Other helpful aspects of ATT-Meta approach:

- Reasoning in system is GOAL-DIRECTED, thereby directed towards being relevant to themes raised in surrounding discourse.
- Various features of ATT-Meta help with processing MIXED METAPHOR (metaphor compounds) of various different structural types.
- Mapping actions are just inference steps:

  full, opportunistic interleaving with other processes.
- No representation of metaphorical views in their own right, and no explicit decisions that a metaphorical view as such is being adopted.

  Rather, facts like "the car is a person" are inferred in the pretence, and these can satisfy mapping guards.

Conclusions and Final Remarks

- *Something like* (perhaps at least crude, streamlined versions of) ATT-Meta's inferential processes may be needed for the more open-ended types of metaphor.
- Such metaphor can crop up in mundane applications.
- The inference needed is mainly what is needed anyway for making sense of situations that might be described in the source subject matter of metaphors.
- Just a little bit of view-specific knowledge needed (mappings and ancillary assumptions). Get huge power from source-side inference and VNMAs.
- In many cases: the most important, or most, or even all, mapping is *non*-view specific.
- Non-parallelism: reduces the amount of input language that needs to be translated into target-side terms, and shifts at least some coherent-scenario-construction to the source side, where (it is plausible that) it can often be done better.

References

Agerri, R. Barnden, J.A., Lee, M.G. and Wallington, A.M. (2007). Default inferences in metaphor interpretation. In B. Kokinov, D.C. Richardson, T.R. Roth-Berghofer & L. Vieu (Eds), *Modelling and Using Context: 6th International and Interdisciplinary Conference* (CONTEXT 2007). Lecture Notes in Artificial Intelligence, Vol. 4635, pp.1–14. Springer.

Barnden, J.A. (2001). Uncertainty and conflict handling in the ATT-Meta context-based system for metaphorical reasoning. In V. Akman, P. Bouquet, R. Thomason & R.A. Young (Eds), *Modeling and Using Context: Third International and Interdisciplinary Conference* (CONTEXT 2001). Lecture Notes in Artificial Intelligence, Vol. 2116, pp.15–29. Berlin: Springer.

Barnden, J.A. (2006). Artificial intelligence, figurative language and cognitive linguistics. In G. Kristiansen, M. Achard, R. Dirven & F.J. Ruiz de Mendoza Ibáñez (Eds), *Cognitive Linguistics: Current Applications and Future Perspectives,* pp.431–459. Berlin: Mouton de Gruyter.

Barnden, J.A. (2008). Unparalleled creativity in metaphor. In *Creative Intelligent Systems: Papers from 2008 AAAI Spring Symposium* (Dan Ventura, Mary Lou Maher & Simon Colton, Cochairs). Technical Report SS-08-03. Menlo Park, Calif., AAAI Press.

Barnden, J.A. (2008). Metaphor and artificial intelligence: Why they matter to each other. In R.W. Gibbs, Jr. (Ed.), *The Cambridge Handbook of Metaphor and Thought*, 311–338. Cambridge, U.K.: Cambridge University Press.

Barnden, J.A. (2010). Metaphor and metonymy: Making their connections more slippery. *Cognitive Linguistics, 21*(1), pp.1–34.

Barnden, J.A. (2012). Metaphor and simile: Fallacies concerning comparison, ellipsis and inter-paraphrase. *Metaphor and Symbol, 27*(4), pp.265–282.

Barnden, J.A. (forthcoming). Mixed metaphor: a pretence-based approach in an AI system, In R.W. Gibbs, Jr. (Ed.), Mixed Metaphor, in compilation.

Carston, R. & Wearing, C. (2011). Metaphor, hyperbole and simile: A pragmatic approach. *Language and Cognition, 3*(2): pp.283–312.

Langlotz, A. (2006). *Idiom creativity: A cognitive-linguistic model of idiom-representation and idiom-variation in English.* Amsterdam/Philadelphia: John Benjamins.

Lee, M.G. & Barnden, J.A. (2001). Reasoning about mixed metaphors with an implemented AI system. *Metaphor and Symbol, 16* (1&2), pp.29–42.

References, contd

Wallington, A.M., Agerri, R., Barnden, J.A., Lee, M.G. & Rumbell, T. (2011). Affect Transfer by Metaphor for an Intelligent Conversational Agent. In K. Ahmad (ed.), *Affective Computing and Sentiment Analysis: Emotion, Metaphor and Terminology,* pp.53–66. Text, Speech and Language Technology 45, Springer.

Zhang, L. & Barnden, J.A. (in press). Towards a semantic-based approach for affect and metaphor detection. *Intl J. Distance Education Technologies.*

Further Material

- The following slides, on miscellaneous things, may be useful but may not be self-explanatory. Contact me for clarification.

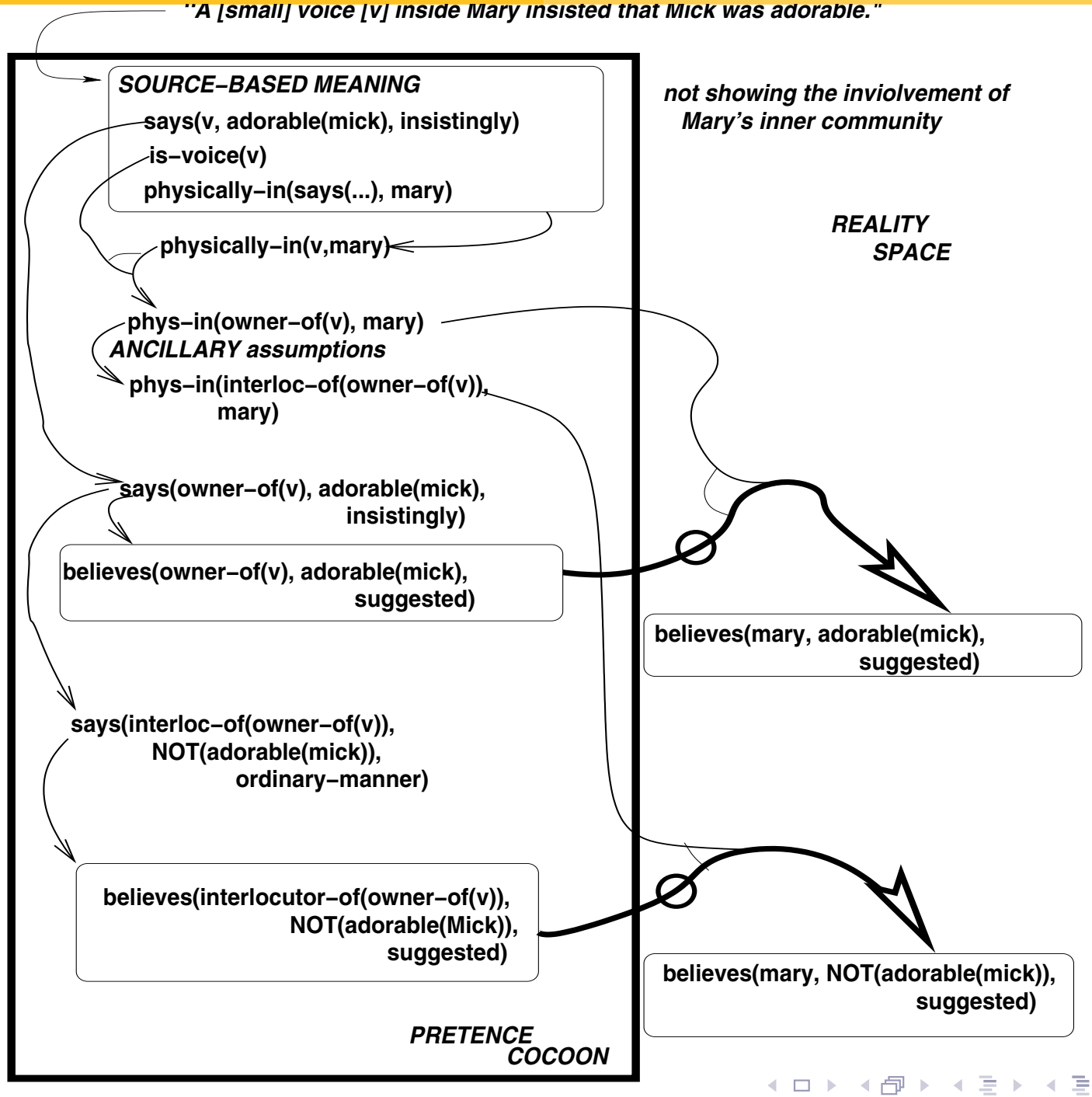
A Conversation Rule: Prolog Form

```
rule(
     the_episode(bel_states, null_time, P, Z, presumed),

         [belongs_to_reality,

          the_episode(being_person, P),
          the_episode(saying, P, Z, M),
          the_episode(being_positive_manner, M)
         ],

     presumed, r_believe_if_say_positively).
```


"A [small] voice [v] inside Mary insisted that Mick was adorable."
SOURCE–BASED MEANING
says(v, adorable(mick), insistingly)
is–voice(v)
physically–in(says(...), mary)
not showing the inviolvement of Mary's inner community
REALITY SPACE
physically–in(v,mary)
phys–in(owner–of(v), mary)
ANCILLARY assumptions
phys–in(interloc–of(owner–of(v)), mary)
says(owner–of(v), adorable(mick), insistingly)
believes(owner–of(v), adorable(mick), suggested)
believes(mary, adorable(mick), suggested)
says(interloc–of(owner–of(v)), NOT(adorable(mick)), ordinary–manner)
believes(interlocutor–of(owner–of(v)), NOT(adorable(Mick)), suggested)
believes(mary, NOT(adorable(mick)), suggested)
PRETENCE COCOON

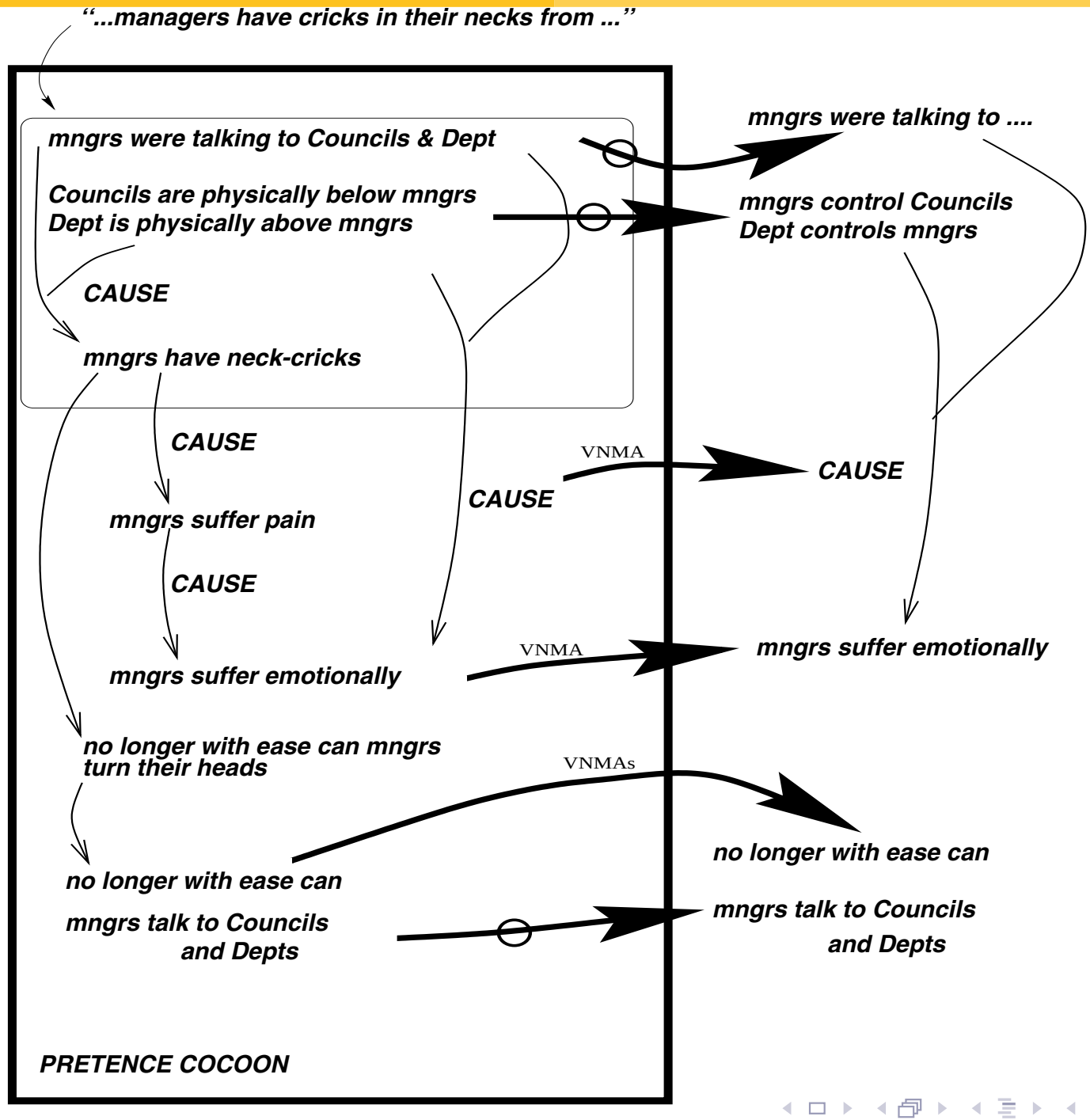
Car Thinks Boot Is Open

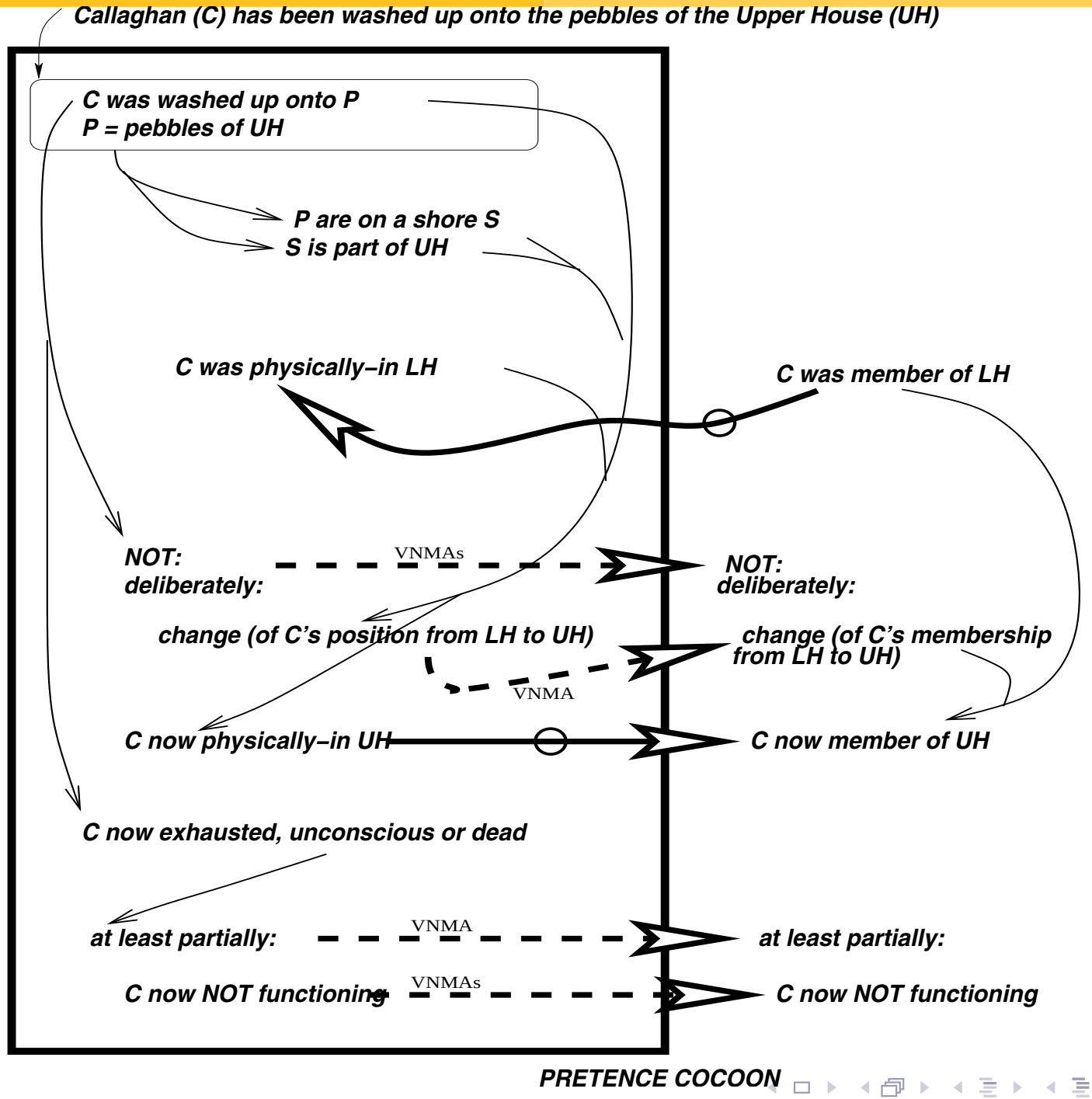
- Slide title is a blog item title on `http://www.audi-sport.net/vb/audi-s4-a4-a4-cab-b7-chassis/109109-car-thinks-boot-open.html`

- The mental state VNMA says that IF a cognitive agent in the real situation corresponds to a *cognitive agent* in the pretence, then their mental states correspond, *modulo* translation of their contents according to correspondences.

- But this doesn't apply in present example, because in reality the car is NOT a cognitive agent, even though it IS a cognitive agent in the pretence.

- There can be a view-specific mapping between an artefact thinking something in the pretence and the artefact behaving in reality as if the something were true.


"...managers have cricks in their necks from ..."
mngrs were talking to Councils & Dept
Councils are physically below mngrs
Dept is physically above mngrs
CAUSE
mngrs have neck-cricks
CAUSE
mngrs suffer pain
CAUSE
mngrs suffer emotionally
no longer with ease can mngrs turn their heads
no longer with ease can
mngrs talk to Councils and Depts
PRETENCE COCOON
mngrs were talking to ....
mngrs control Councils
Dept controls mngrs
VNMA
CAUSE
CAUSE
VNMA
mngrs suffer emotionally
VNMAs
no longer with ease can
mngrs talk to Councils and Depts


Callaghan (C) has been washed up onto the pebbles of the Upper House (UH)
C was washed up onto P
P = pebbles of UH
P are on a shore S
S is part of UH
C was physically–in LH
C was member of LH
NOT:
deliberately:
VNMAs
NOT:
deliberately:
change (of C's position from LH to UH)
change (of C's membership from LH to UH)
VNMA
C now physically–in UH
C now member of UH
C now exhausted, unconscious or dead
at least partially:
VNMA
at least partially:
C now NOT functioning
VNMAs
C now NOT functioning
PRETENCE COCOON

Reverse Transfer (i.e. from Reality to Pretence)

Reverse transfers are often desirable in metaphor understanding:

- Saw simple example in Callaghan / House of Lords example.
- Enables non-metaphorical information and metaphorical discourse fragments to create a coherent, holistic scenario in the *pretence* from which reality information can be opportunistically drawn.

- Integration of information may be more natural on pretence side than reality side.

  One reason: may have greater familiarity with how the source subject matter works in detail: richer background knowledge and inference abilities; perhaps efficient, specialized inference procedures available for it.

  But also: not all metaphorical fragments are susceptible to being individually translated into reality terms. So when metaphorical and non-metaphorical sentences are mixed, the non-metaphorical ones need to be "metaphorized."

Metaphorization

I tried not to run down Phil too much - I felt bad enough as it was, what with screwing his girlfriend and all. But it became unavoidable, when Jackie expressed doubts about him. I nurtured those doubts as if they were tiny, sickly kittens. Eventually they became sturdy, healthy grievances. These cats had their own cat-flaps. This allowed them to wander in and out of our conversation at will.
[adapted from Nick Hornby, High Fidelity, 1995]

The cat-flaps and at-willness don't themselves need target parallels. They just emphasize, via the source scenario, the non-deliberateness (on the part of the conversants) with which the grievances occurred in the conversations.

Even the cat-ness in the source scenario has no target-side parallel. It just provides a framework for describing a process in which doubts become strong grievances.

Cats, contd

"These cats had their own cat-flaps."

This sentence does not (need to) have its own target-side meaning.

It is intuitively natural to build in one's mind a scenario of the sickly kittens becoming healthy kittens or adult cats.

But where is this biological recovery and growth implied? Answer: in the sentence "Eventually they became sturdy, healthy grievances."

And if we claimed that the integration should instead happen on the target side, then there'd be more pressure to convert all sentences including "These cats had their own cat-flaps" into target terms.