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Intuitive and reflective inferential processes

1. Background:
Three-tiered massive modularity

The Standard View

The human mind/brain is a general learning/memory/inference system with specialized input (perception) and output (action) sub-mechanisms

The Massive Modularity Thesis

The mind/brain is an articulation of specialised cognitive modules, leaving relatively little place to truly general mechanisms

NB : modularity ≠ innateness

What is a module?

A cognitive module is an automous mental device characterized by

- Specific inputs
- Specific procedures
- Specific outputs

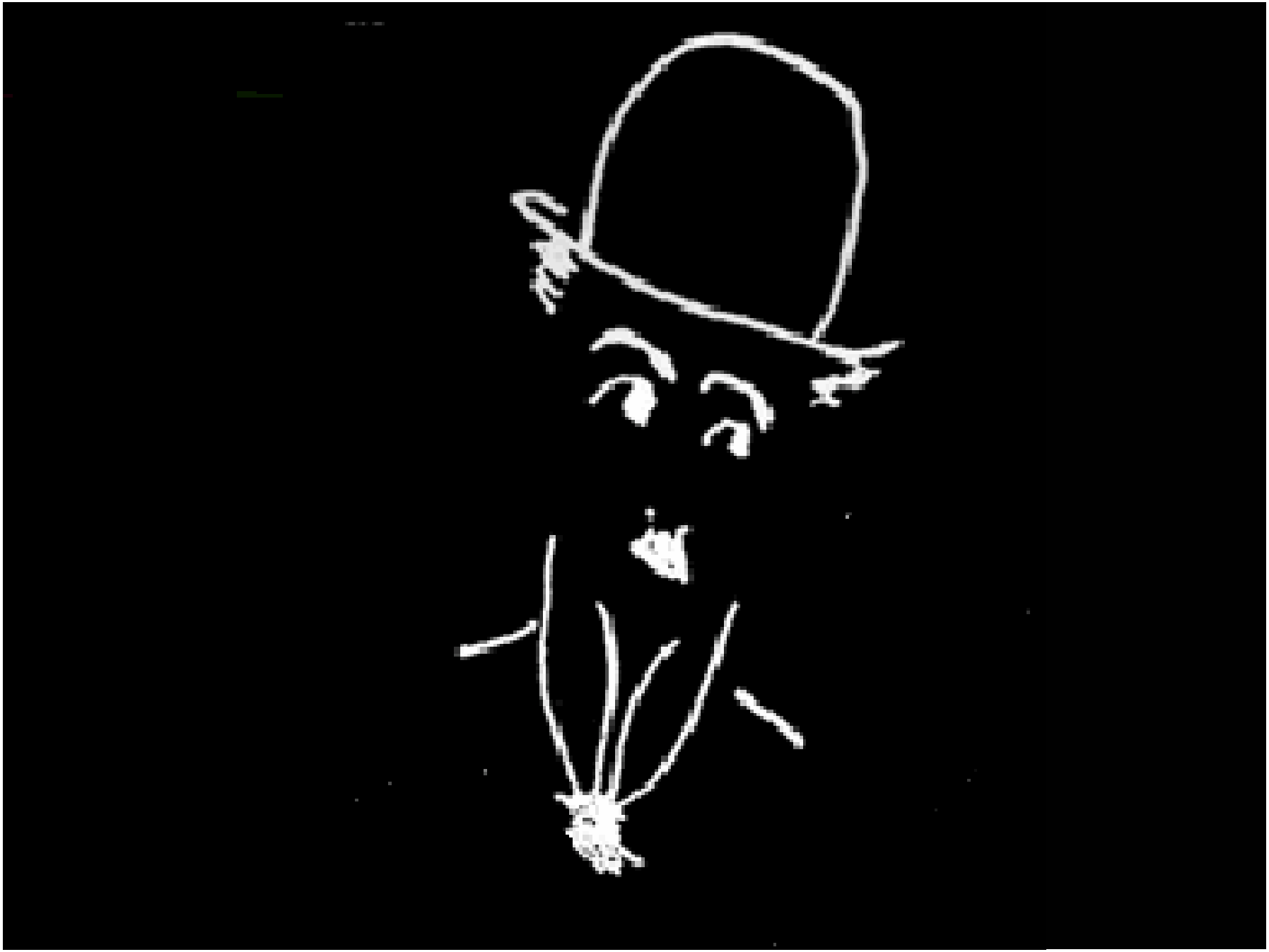
Examples of possible modules

- Avoidance of impending collisions
- Face recognition
- “Theory of Mind”
- Language faculty
- Knowledge of English
- Reading

The proper and actual domain of modules

- Modules have the function of processing information belonging to a give domain (e.g. faces, English utterances, etc.), their **“proper domain”.**

- They actually process information that meets their input conditions, whether or not it belongs to their proper domain. This information constitutes their **“actual domain”**



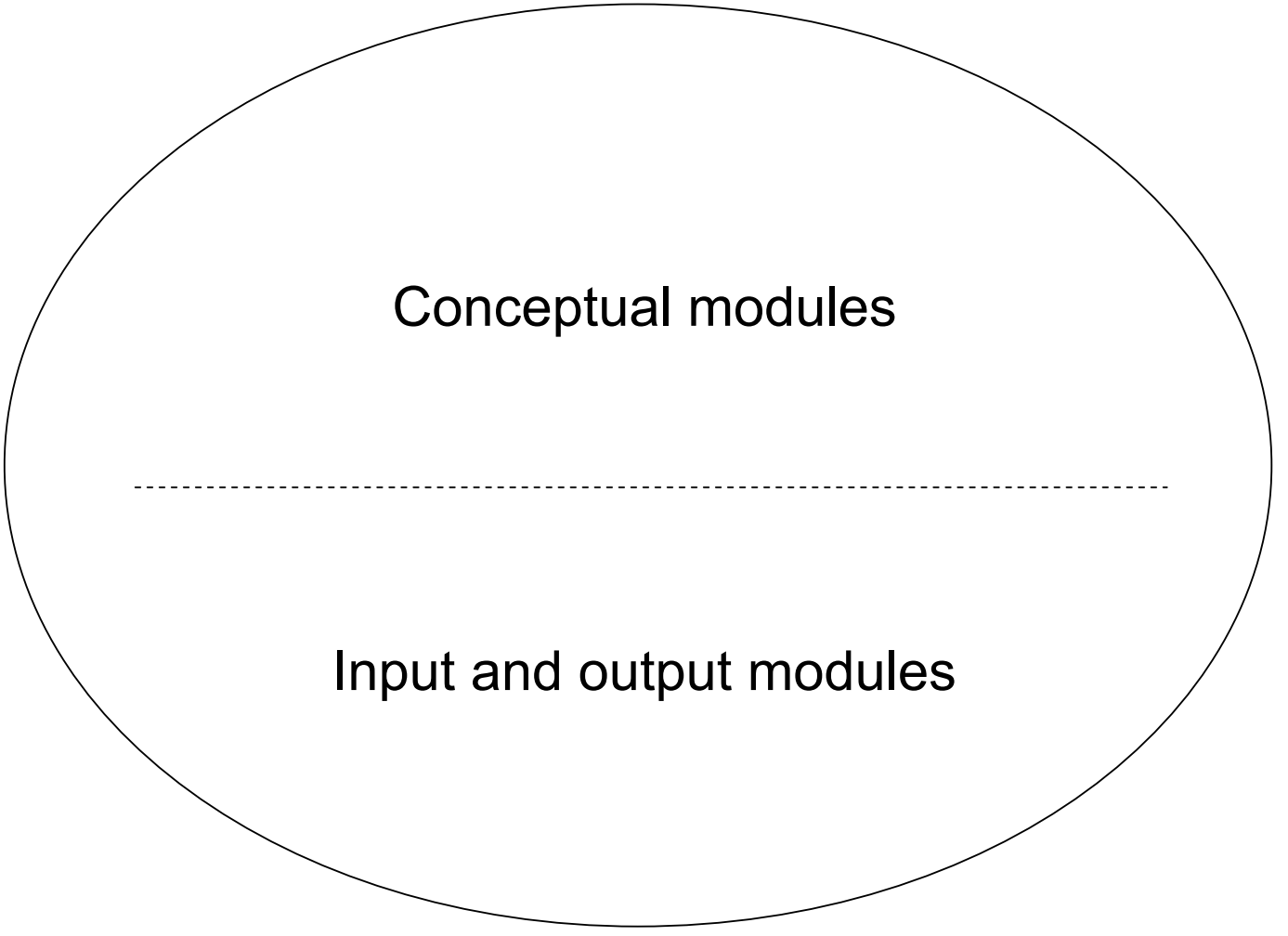
Competition among modules

- Modules with inputs matching their input conditions compete for energy in order to process these inputs

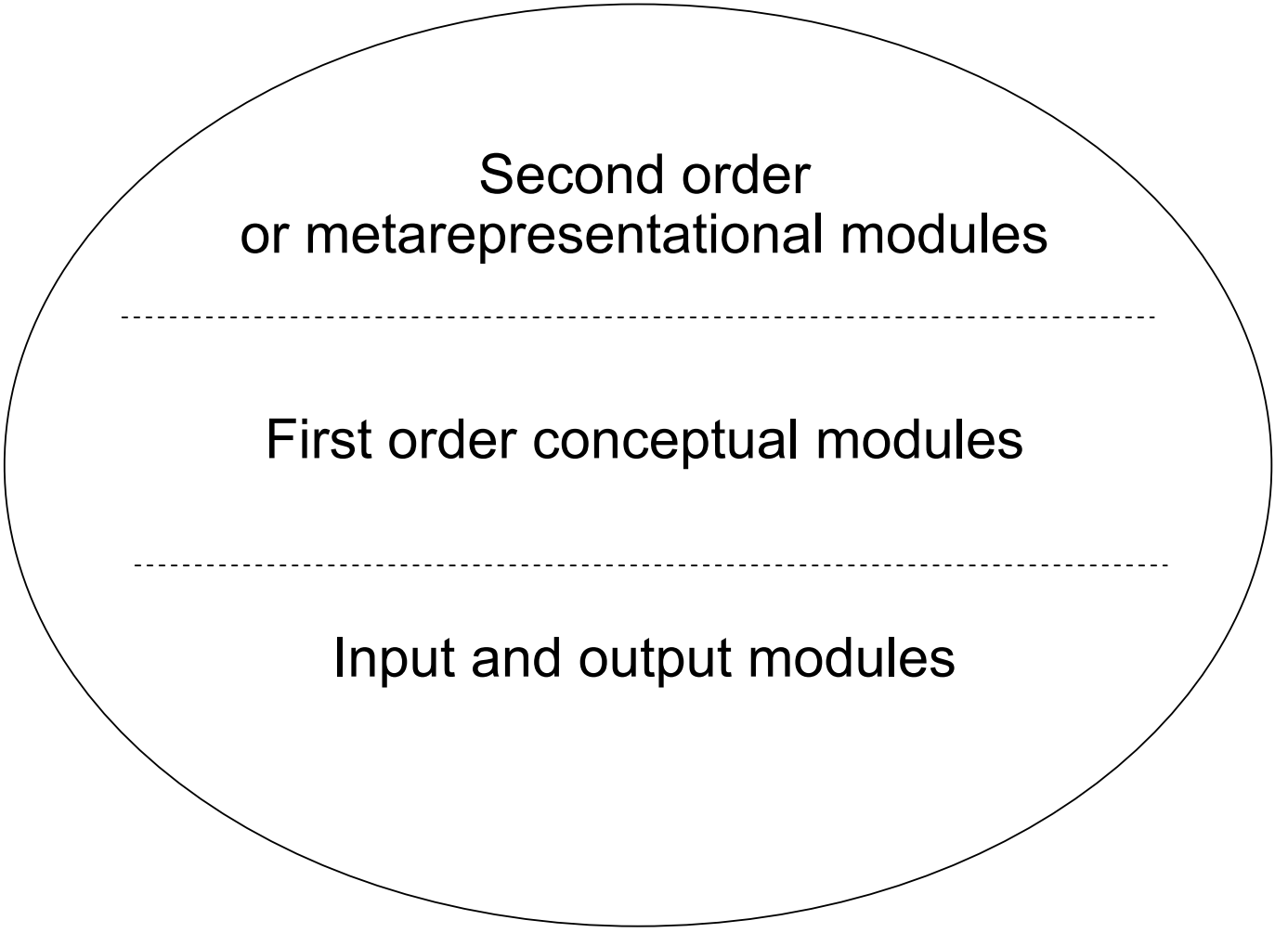
- Modules the output of which has the greatest expected relevance win

- It is not enough to have an initial activation for the modular process to run its course

A Simple View of the Massively Modular Mind:



A Three-tiered View of the Modular Mind:



What are metarepresentational modules?

- Metarepresentational modules construct and process representations of representations

- They attend to properties of the representations rather than to properties of the things represented

Examples of possible metarepresentational modules

- Naïve psychology ("Theory of mind")
- Verbal comprehension (possibly a sub-module of naïve psychology)
- Argumentation module

Virtual domain-generality

- Metarepresentational modules are domain-specific in that they process only representations and attend only to properties characteristic of representations
- However the representations metarepresented can be about anything in any domain
- Hence metarepresentational modules provide a kind of “virtual domain-generality”

2. Inference and reasoning in a modular mind

Inference

Process that derives output assumptions (or *conclusions*) from input assumptions (or *premises*) in an epistemically sound way

- Inference is an essential ingredient of any conceptual system

Reflection

Thinking about one's own thoughts (hence a variety of metarepresentational process)

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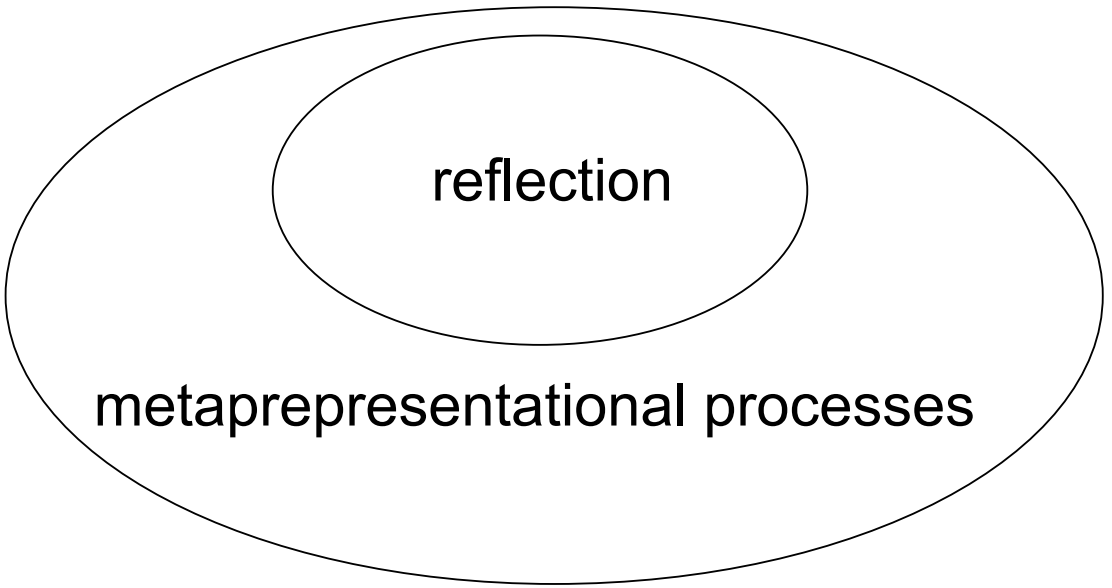

Reasoning

Reasoning is reflective inference

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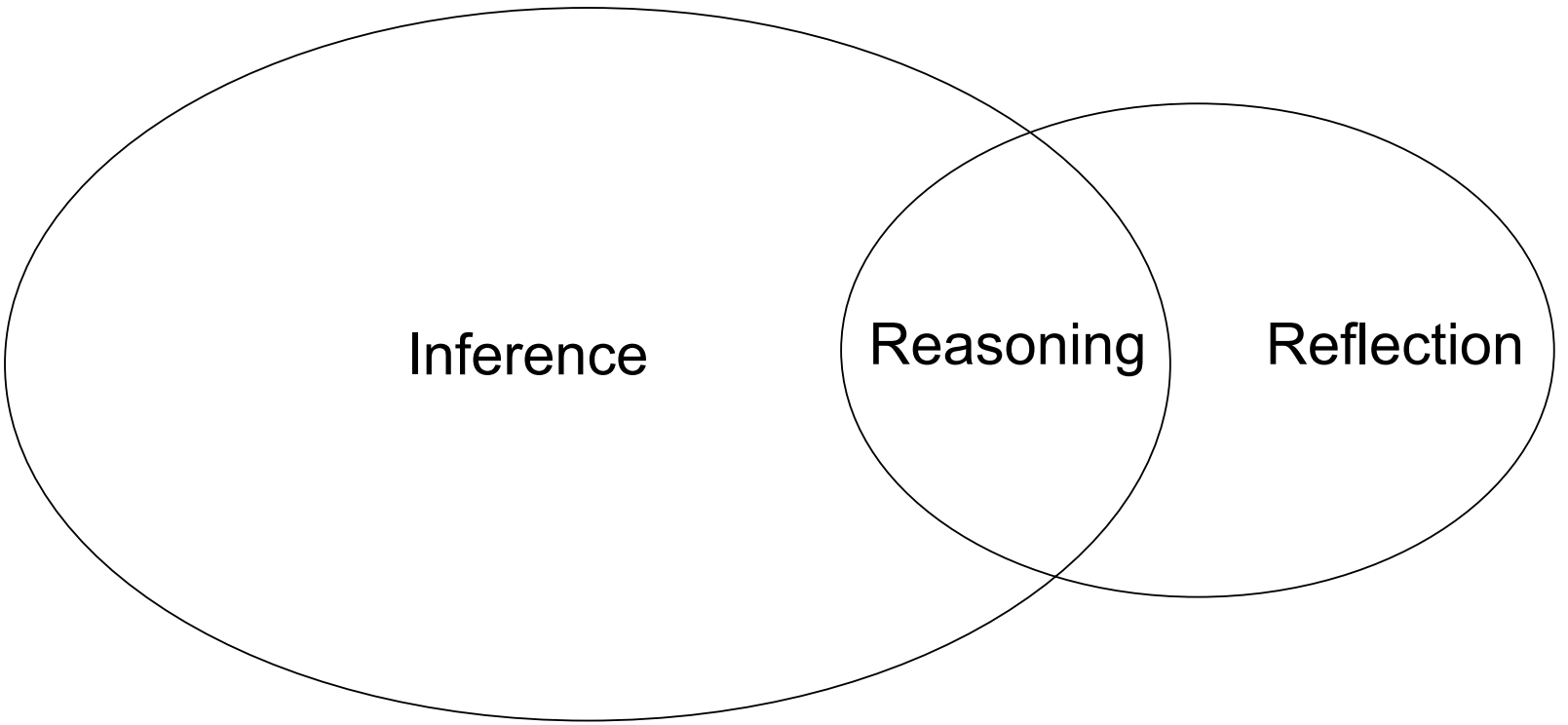


Intuitive vs reflexive inference

- In intuitive inference, the conclusion is accepted without attention to reasons
- In reflective inference (i.e. reasoning) reasons for the conclusion are attended to
- The basic steps in a reasoning are each intuitevely inferred

- You walk out of your house, you see fast moving dark clouds, feel a strong chilly wind, you spontaneously come to expect that it might rain. **[*Intuitive inference*]**

- You look at the barometer and at the thermometer, see that both pressure and temperature have suddenly dropped, and you tell yourself: "this means that it might rain.“ **[*Reflective inference (i.e. reasoning)*]**

Peter: did you like my pasta?

Mary: yes, I did

Peter understands Mary to be saying that she liked his pasta.

[*Intuitive inference*]

Peter is aware that Mary, being polite, could not say less, and comes to the conclusion that probably she did not like his pasta.

[*Reflective inference (i.e. reasoning)*]

Reasoning is not an essential ingredient of a cognitive system

- Cognition can and does go on without reflection and hence without reasoning
- Reasoning may be no less fallible than intuitive inference
- Reasoning is costly
- To the extent that perception and intuitive inference are reliable, the benefits of reasoning are unclear

3. Explaining reasoning

Why Do Humans Have Reasoning at All?

- "Cartesian" view: To enhance individual cognition

“there is nothing so far removed from us as to be beyond our reach, or so hidden that we cannot discover it, provided only we abstain from accepting the false for the true, and always preserve in our thoughts the order necessary for the deduction of one truth from another.“

Descartes

Why Do Humans Have Reasoning at All?

- "Cartesian" view: To enhance individual cognition

- Evolutionary approach: To increase the acceptability of communicated information

An evolutionary argument: cooperation

- Cooperation is advantageous to honest cooperators but even more so to dishonest ones
- Hence, for cooperation to evolve, dishonesty must be prevented
- In the human case, it is prevented by cognitive means

An evolutionary argument: communication

- Communication is advantageous to honest communicators but even more so to dishonest ones

- Hence, for communication to evolve, communicated information must be adequately filtered

- In the human case, it is filtered in particular by means of reasoning

Ways to Filter Communicated Information:

- Trust people who are benevolent and competent
- Watch for behavioral signs of honesty or dishonesty
- Check communicated information for consistency (both internal and external)

Ways to Persuade a Cautious Audience:

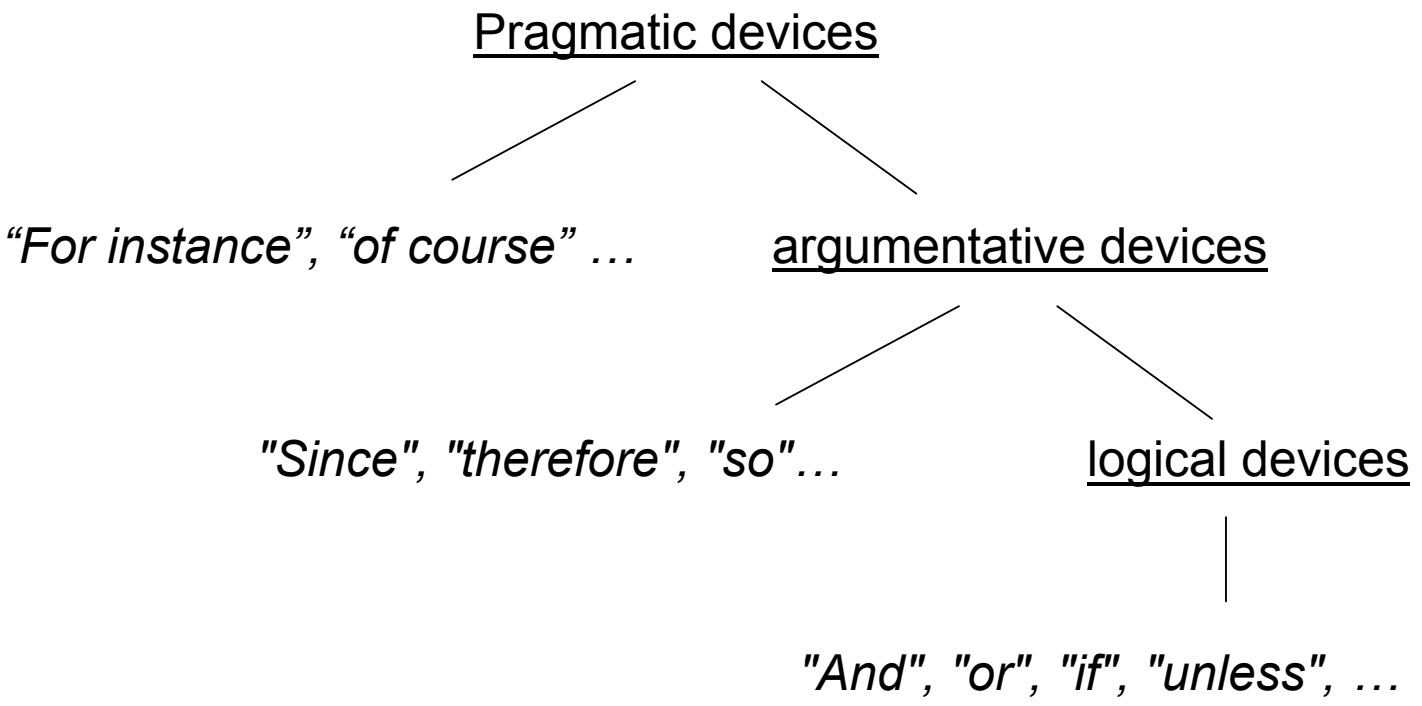
- Do no directly assert what your audience won't accept on trust, let them infer it
- Give evidence and arguments for the intended conclusion
- Help your audience derive the intended conclusion
- Highlight logical or evidential relations between premises the audience is willing to accept and the intended message

Argumentation

- Arguing consist in displaying the consistency relationships between premises the audience is willing to accept and conclusions which they won't accept on trust

- Arguing is a costly, hard-to-fake "honest display strategy"

Linguistic Tools for Persuasion:



The intuitive aspect of reasoning

- Reasoning involves intuitions about logical and evidential relationships among representations

- The resources for deriving these intuitions are activated in a dialogic context (actual, intended, or imagined)

Implications of modularity

- The **proper domain** of the argumentation module in receiving mode is the output of the comprehension module, i.e. interpretations of actual utterances

- The **actual domain** comprises also pseudo-utterances, e.g. inner speech, Cartesian reflection, and also experimental material

- The **full activation of the module** depends on the expected relevance of its output (greater for real arguments or inner speech than for artificial material)

4. Some general predictions

The function of reasoning

- Classical view: reasoning
  - Has an epistemic goal
  - Helps decision making
  - Helps when confronted with new situations

- Argumentative theory: reasoning
  - Evaluates support relationships between representations

Predictions

- Classical view:
  - Reasoning should apply across the board
  - Its successes and failures should be accounted for by the limited capacity of reasoning and the difficulty of the tasks

- Argumentative theory:
  - Reasoning should be triggered more easily in dialogic and argumentative contexts

When is reasoning efficient?

- Decontextualized deductive reasoning?

“it must be said that logical performance in abstract reasoning tasks is generally quite poor.”

(Evans 2002)

Explanations of poor performance

- Classical view:
  - Cognitive limitations (e.g. working memory limitations)

- Argumentative theory:
  - The input conditions for the reasoning module are not met

  or

  - The expectation of relevance is too low for the reasoning process to run its course

When is reasoning efficient?

- Decontextualized deductive reasoning?

- Reasoning in argumentation?

Reasoning in argumentation

First results by Kuhn: our argumentative skills seem to suffer from several flaws

- Methodological problems
- New results
  - Brem & Rips (2000) show that we can be good at making the explanation / evidence distinction
  - Pennington & Hastie (1993) show that we can be good at building counterarguments

- Macrostructure of arguments (Ricco 2003)
- Commitments and burden of proof (Baillenson & Rips, 1996; Rips 1998)
- Recognizing circular reasoning (Rips 2002)
- Using hypothetical thinking in argumentation (Green et al. 2006)
- Recognizing fallacies (Neuman et al 2006; Weinstock et al 2004; Neuman et al 2004)

The example of *modus tollens*

– Poor performances in ‘decontextualized’ settings

– In more naturalistic situations: “reasoning in terms of ‘negation’ (by contradiction, and by negative deduction (*modus tollens*)) is surprisingly common” (Pennington & Hastie 93)

“…we are impressed by the coherence of the reasoning displayed. Participants … appear to build complex argument and attack structure. People appear to be capable of recognizing these structures and of effectively attacking their individual components as well as the argument as a whole.”

(Resnick et al. 1993)

When is reasoning efficient?

- Decontextualized deductive reasoning?
- Reasoning in argumentation?
- Group reasoning?

Group reasoning

- The argumentative theory predicts that people should be sensitive to good arguments and justifications

- Group processes may improve performances

- Works by Laughlin and colleagues

  – Mathematical and logical problems
    - Truth wins
  – Inductive problems
    - Truth supported wins
  – Judgmental problems
    - Majority wins

(Laughlin & Ellis 1986; Laughlin 1999; Laughlin et al 2002)

- Moshman & Geil (1998) experiment on the Wason Selection Task

Initial and Final Patterns Selected by Members of Individual/Interactive Groups

	Final Selection Pattern			
Initial Selection Pattern	$p\ \bar{q}$	$pq\ \bar{q}$	p	*Total*
$\bar{p}\ \bar{q}$	10	1	1	12
$pq\ \bar{q}$	2	0	0	2
p	4	0	2	6
$p\ q$	21	4	2	27
All cards	4	1	0	5
$\bar{p}\ \bar{p}$	3	0	1	4
$\bar{p}$	1	0	0	1
Total	45	6	6	57

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- The “two wrongs make a right” phenomenon
  - (Schwark et al. 2000; Doise et al. 1975; Doise & Mugny, 1979; Glachan & Light, 1982)

The confirmation bias

- An ubiquitous phenomena (Nickerson 1998; Kunda 1990)
  - Preferential treatment for the hypotheses that support our beliefs (Wyer & Frey 1983)
  - Overweighing of the examples that fit our beliefs (e.g. Kunda 1987)
  - Finding (only) what we are looking for in data (Snyder 1981, 1984; see Nisbett & Ross 1980)
  - Problems with belief revision (e.g. Ross & Lepper 1980)
  - Problems with generating counter arguments against claims we hold (e.g. Kuhn 1990)
  - …

Explanations of the confirmation bias

- Classical view:
  - Useful heuristic in some cases only
- Argumentative theory:
  - Means to help us win arguments
  - Can be seen as a division of labor

5. Conclusions

The evolutionary, three-tiered massive modularity approach helps explain:

- The very possibility of reasoning
- Its apparent domain-generality
- Its basic function
- The conditions under which it fails

Question

What new experiments would help us test this view of reasoning?