Intuitive rationality and cognitive expertise

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Theoretical background

The two cognitive systems

intuitive system (1)	reflective system (2)
associative	analytic
automatic	controlled
fast processing	slow processing
rigid	flexible
contextual	detached
pragmatic	abstract
implicit	explicit

Theoretical background

intuitive system (1)

associative	Encodes:	Object/event categories
automatic		Affordances
fast processing		Structural information
rigid		Causal & functional dependencies
contextual		
pragmatic	Processes:	Non-symbolic
implicit		Action/outcome centered
		Sensitive to needs, goals,
		and capabilities of the agent

The intuitive system is an associative learning device that tracks the regularities in the environment that have pragmatic relevance to us as situated and embodied agents.

Intuition and cognitive expertise

1. We are exceptionally competent practical reasoners.

   -common sense is extremely difficult to model computationally

2. We are surprisingly *in*competent abstract reasoners.

   -cognitive biases abound

   -even highly trained experts are susceptible to the common reasoning biases

3. Reasoning biases are usually produced by intuitive processing

4. Expert skills are, by and large, executed by the intuitive system.

   Are, therefore, scientists and other experts in the business of abstract reasoning performing suboptimally in a systematic fashion?

The answer: yes and no

To the extent that abstract reasoning becomes practical daily routine the abstract/practical distinction ceases to be psychologically relevant.

At least in the routine reasoning tasks, the intuitive system gradually learns the actually relevant variables and dependencies, like relevant causal or logical relations and especially context dependent outcomes of actions.

But the result is not an acquisition of abstract reasoning skill but a domain or even instance specific transformation in the task understanding.

Often the relevant environment is at least partly socially constructed, and this is especially true when working within abstract domains. The structure our intuitive system adapts to is not necessarily optimal, especially if the relevant intersubjective norms are biased.

The abstract Wason selection task

Rule: Every card which has a vowel [A] on one side, has an even number [4] on the other side.

Pick those, and only those, cards that has to be turned over to check whether the claim about the cards was true.

$$\begin{array}{cccccc}
\text{modal:} & \blacktriangledown & & \blacktriangledown & & 50\% \\
& \text{A} & \text{D} & \text{4} & \text{7} & \\
\text{normative:} & \blacktriangle & & & \blacktriangle & 10\% \\
& p & \neg p & q & \neg q &
\end{array}$$

Normative model: evaluation of the material implication $p \rightarrow q$

A thematic selection task

Rule: If an envelope is sealed then it has a 50 lire stamp on it.

sealed	not sealed	50l stamp	40l stamp	normative answers: 80%
▲			▲	modal answer

Johnson-Laird, Legrenzi & Legrenzi 1972: Reasoning and a Sense of Reality

BUT, the result has failed to replicate:

sealed	not sealed	50c stamp	40c stamp	normative answers: 10%
▲		▲		modal answer

Griggs & Cox 1983: The elusive thematic materials-effect in Wason's selection task

Deontic selection task

On this task imagine that you are a police officer on duty. It is your job to ensure that people conform to certain rules. The cards in front of you have information about four people sitting at a table. On one side of a card is a person's age and on the other side of the card is what the person is drinking. Here is the rule:

if a person is drinking a beer, then the person must be over 19 years of age.

Normative answers: 87%

Deontic selection task

There exists a tribe known as The Kaluame. Cassava root is a rare and powerful aphrodisiac, making men irresistible to women. Among the Kaluame, only married men have tattoos on their faces. The elders have established the cassava rule because they strongly disapprove of sexual relations between unmarried people. Many unmarried men, however, are tempted to cheat. You are a guard whose task it to catch persons breaking the law. Each card has information about a Kaluame man. One side tells which food the man is eating, and the other side tells whether the man has a tattoo on his face or not.

if a man eats cassava root, then he must have a tattoo in his face.

Normative answers: 75%

Deontic selection task

Non-social deontic rules also facilitate performance:

-If you clean spilled up blood, you *must* wear rubber gloves.

-If an envelope is sealed then it *must* have a 50 lire stamp on it.

-If one is to take action A, then one *must* first satisfy precondition P.

1. Mere insertion of the word "must" 10% $\rightarrow$ 60% normative answers.
2. Giving a rationale for deontic rules 30-60% $\rightarrow$ 80–90% normative answers.
3. No effect on familiar rules.

Overview

abstract (unfamiliar)	< 10%
thematic unfamiliar	< 10%
deontic, abstract or unfamiliar	30–60%
(thematic, familiar by an analogy	30–60% *)
thematic or deontic familiar	80–90%
deontic with a rationale	80–90%

* E.g. Almor & Sloman 1996: Is Deontic Reasoning Special?

Explanations:

1. Specific experience explanation (Griggs & Cox 1983)

   partly correct, but does not explain unfamiliar deontic tasks

2. Pragmatic reasoning chemas (Cheng & Holyoak 1985)

   partly correct, but does not explain context effect in deontic tasks.

3. Cheater detection module (Tooby & Cosmides 1992)

   incorrect predictions about non-social deontic tasks.

4. Bayesian rational analysis (Oaksford & Chater 1996)

   probably correct in explaining the selection pattern in abstract selection task.

5. Rational analysis with deontic logic (Stenning & van Lambalgen 2004)

   needs mechanistical explanation and does not explain the context effects.

6. Relevance theory (Sperber, Cara & Girotto 1995)

   correct, but perhaps trivial without mechanistical explanation.

Outline of the model of intuitive processing

1. Behavior in abstract reasoning tasks results from the lack of an interpretation of the implication.

   -Subjects employ intuitive fall-back procedures

   -Bayesian exploratory behavior explains the selection pattern $p > q > \neg q > \neg p$

   -A mix of fall-back mechanisms is likely, e.g. matching/discursive relevance

2. The system uses instance specific encoding (exemplars) to store successful tasks/action -pairs.

3. The system exploits pattern recognition (prototypes?) to match novel tasks against the existing knowledge base.

   $\rightarrow$ analogical transfer: initially surface features are the most salient cues

   -the more structurally identical exemplars accumulate in the knowledge base, the more easier it is to find a relevant match

   -repeatedly co-occurring structural features and verbal cues eventually bind to each other producing approximately word-level, domain specific schemata

Obvious conclusions

1. The key factor in explaining deontic selection task behavior is the fact that the rules we learn throughout our life are mostly deontic. That is why (at least almost) every adult has internalized the socially shared inferential structure of deontic concepts. The acquired intuitive understanding of deontic concepts eliminates biases.

2. The same should hold for any day-to-day conceptual domain like folk physics and folk psychology.

3. Obviously the reasoning of practicing scientist and other experts should be equally free of biases *in their area of expertise*.

4. But: Nothing guarantees that expertise in one (initially) abstract domain implies better reasoning ability in general.

Practically relevant conclusions

1. Intuitions demonstrably are *not* reliable outside our everyday experience: zombie worlds, social utopias, thought experiments in general.

2. Our actual operating environments are often partly socially constructed. Especially in theoretical disciplines the discursive, argumentative, and other social practices largely constitute the relevant demands. Unhealthy social practices may contaminate our individual reasoning:

   -social psychological phenomena, like negative stereotyping, can affect our judgment more that we acknowledge

   -problems with insulated knowledge producing communities and excessive specialism: highly entrenched but idiosynchratic intuitive understanding can harm interdisciplinary co-operation

   -initially quite arbitrary but compelling ideas may end up as axiomatic facts that are taken as given, or at least may appear as highly relevant, just because they are frequently referenced, etc.

Main theoretical points

If we are to conduct a rational analysis of human behavior in domains that are even partly socially constructed, which means practically any domain, we have to take into account the fact that the actual demands posed by the relevant environment may be suboptimal. Individuals may operate completely rationally in their respective (intellectual) environments, but still violate widely accepted epistemic virtues and utility models or other formal standards.

What are generally considered as reasoning biases are sometimes actually problems in task construal. The subjects do not necessarily *reason* any better or worse when they produce biased responses in comparison to when they produce normative answers. The Wason selection task paradigm should be considered as a branch of research that investigates concepts, not inferential processes.