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Epistemological approaches important for IS modeling

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1 Motivation

Epistemological approaches:
Is there only one single epistemology? or:
What relations between reality and model can you imagine?

Situation: epistemological complexity

Answers from humanities are not sufficient, therefore reduction to axioms:

1 Which of Popper’s three levels of existence is accessible to cognition?
2 In what way is world 1 accessible to cognition?
3 In what quality and to what degree is world 1 accessible to cognition?
4 Is definite, objective knowledge of world 1 possible?

<table>
<thead>
<tr>
<th>Relation reality – model World 1 – World 3</th>
<th>Epistemological approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 1: to find, to (re)discover descriptive categories</td>
<td>naïve realism</td>
</tr>
<tr>
<td>a certain: some coincidence, some distortion: to (suitably) invent descriptive categories</td>
<td>critical realism, moderate constructivism</td>
</tr>
<tr>
<td>no: to arbitrarily invent descriptive categories</td>
<td>radical constructivism, idealism, solipsism</td>
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</table>
2 Realism 1 --- 2.1 Naïve realism 1

– assumes a **one-to-one (isomorphic) correspondence**
  between reality and model
– corresponds to a sensualistic mapping theory

Both assumptions are completely **obsolete**.

We can find a lot of arguments against naïve realism in IS/IT, e.g.,
– reduction of W1-complexity in W3-models,
– influence of the model designer on his models,
– mutual influence of model designers and employees

Arguments from biology (sensory and brain physiology) and
**psychology of gestalt**:
– **distortion** by perception
– **optical illusions**, e.g. Müller-Lyer, contrast intensification
– ‘retinal abstraction’: – contour intensification
  – color reduction (colored windows)
– three bowls of water (asymmetric reaction)
– symmetric reddening of skin after one-sided impact of heat
  etc.

**Therefore, we know that human perceptions and human models do not completely coincide with the reality.**

You cannot completely rely on human knowledge.

Distortion effects of that kind arise
already with regard to simple optical objects,
the more with regard to more complex objects,
such as organizations as open social systems.

**Naïve realism has to be refused in IS from the very beginning.**
2 Realism 2

2.1 Naïve realism → critical realism

Müller-Lyer’s optical illusion
German sociologist and psychiatrist
(Rock, Wahrnehmung, 1998 [1984], 139)
2 Realism 3

2.2 Critical realism

similar: strong critical realism
similar: hypothetic realism (weakest form) Vollmer, EE, 1975, 35

There is always some distortion of reality by – the model designer’s – active and interpreting perception, description and formalization. Therefore, a one-to-one (isomorphic) correspondence between reality and model is impossible.

In spite of this distortion of reality, there is some relation between reality and models, between immanent categories and descriptive categories.

What about descriptive categories which humans define, e.g. in mathematics? They are used, but do they exist and how? Are there corresponding immanent categories?

The ideal form of a triangle does not occur in nature, cannot be observed, numbers do not occur either, only certain quantities of similar objects, mathematical equations do not occur in nature. There are different levels of existence.

These considerations lead to moderate constructivism.
2 Realism 4

2.2 Critical realism → moderate constructivism

\[(2a-3bx)(-5ax+b) = 5x^2-6b\]
3 Constructivism 1

3.1 Moderate, weak constructivism

**Critical realism** underlines that models are reconstructions, lays stress on the reconstructed parts of human knowledge, lays stress on the existence of an independent reality.

**Moderate constructivism** underlines that models are constructions lays stress on the constructed parts of human knowledge, lays stress on the existence of constructions.

**Fact 1:**
Every (re-)construction (interpretation) of reality is determined by biological and social norms of perception and, therefore, contains some constructed part (how big?).

**Statement:**
If some relation to empirically observable reality is intended, human constructions are not completely free and arbitrary.

**Fact 2:**
There are areas of science where constructions are arbitrary: mathematics (definitions of mathematical categories).

**Statement:**
There are domains of human knowledge with external reality, that is, descriptive categories with immanent categories, and domains of human knowledge without external reality, that is, descriptive categories without immanent categories.

What about the idea of completely independent human knowledge no matter whether an external reality exists or not? If reality were mere fiction, nothing but a human construction?
3 Constructivism 2

3.1 Moderate → radical constructivism

Reference?
3 Constructivism 3

3.2 Radical, hard constructivism 1

Applies to mere artefacts / constructions / speculations without any relation to an observable reality.

These constructions are free and arbitrary.

It doesn’t matter whether an independent reality exists or not, humans consider their constructions as their reality and live in a world of descriptive categories.
3 Constructivism 4

3.2 Radical, hard constructivism 2

Adaptionism / objectivism vs. constructivism / subjectivism

(Riedl, Mit dem Kopf durch die Wand, 247)
4. Preliminary results

We have arrived at a very strange situation.

4.1 Doubts about human perception of reality

Are human-made models reliable?
Can we judge the distortions?

Critical realism states that there is some distortion of reality by perception, description and formalization.

But where, up to which degree, why?

Critical realism does not give any explanations with regard to
– areas of distortions
– degrees of distortions
– reasons for distortions
– reasons for false judgments.

Questions:
Is human perception, the human cognitive equipment, a cognitive / epistemological prison?
– Yes: Edgar Allen Poe (1809-1849): The spectacles
– Eye and sun: Is there a pre-established harmony?

In order to find answers to these questions, we have to proceed to evolutionary epistemology.
4. Preliminary results

4.1 Doubts about human perception of reality

Human cognitive prison (Oeser, Psychozoikum, 1987, 91)
4. Preliminary results 3

4.2 Contradictory epistemological approaches

Are the four epistemological approaches mentioned completely contradictory or even compatible?

This question can be solved with an epistemological step model.

From objectivity via subjectivity to constructivism
(Goorhuis, Modellbildung, 1994, 93)
5 Evolutionary epistemology (EE) 1

5.1 Evolutionary origin of the cognitive a priori 1

Konrad Lorenz 1941 gives a biological reinterpretation of Kant: “Kant’s doctrine of the a priori in the light of contemporary biology.”

There is phylogenetic (evolutionary) experience before ontogenetic (individual) experience: Individual a priori is evolutionary a posteriori.

Kant’s categories, that is the ways / forms of human perceptive interpretation, are innate: time, space, causality, hierarchy etc.

Kant’s categories do not have any transcendental origin, but an evolutionary origin (by mutation and selection).

Kant’s a priori = Lorenz’s cognitive apparatus (“Weltbildapparat”)

The human cognitive apparatus / equipment is a product of evolution (by mutation and selection) as well as its innate ways / forms of perceptive interpretation (Kant’s categories) and the cognitive strategies it uses.

Only where selection had influence on cognitive equipment, there is some kind of analogy between reality and sensory-mental interpretations (phenomena = “Erscheinungen” [Kant]), reconstructions of the reality: changes in reconstructions correspond to changes in reality (e.g. movements).
5 Evolutionary epistemology 2

5.1 Evolutionary origin of the cognitive a priori 2

“Immanuel Kant’s cognitive model
(Mårtensson / Nilstun, Vetenskapsteori, 1988, 25)

“If the eye were not sunlike, it could never see the sun.”
(Motto to Konrad Lorenz “Behind the mirror” from Goethe, Zahme Xenien)

Why is the eye sunlike?

There is no pre-established harmony between sun and eye as Kant would have put it.

The fact that we can see the sun is a consequence of the evolutionary adaptation of the human eye to the wave-length maximum of the sun radiation.
5 Evolutionary epistemology

5.1 Evolutionary origin of the cognitive a priori

(Churchland / Sejnowski, Computational brain, 1997, 288)

Maximum of sun radiation: green light
(Vollmer, Evolutionäre Erkenntnistheorie, 1990 [1975], 98)
5 EE 4 --- 5.1 EE’s evolutionary ‘mirror’ 1

As the evolutionary mirror is an answering mechanism (Lorenz), human cognition corresponds to and reflects qualities of W1. The human perceptive apparatus is not a total prison.

<table>
<thead>
<tr>
<th>‘mesocosmic’ reality (inorganic)</th>
<th>Answer of the evolution (organic): ‘reflection’ (Konrad Lorenz), approxim. prelimin. hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>water</td>
<td><strong>anatomic equipment:</strong></td>
</tr>
<tr>
<td>air</td>
<td>fin of a fish</td>
</tr>
<tr>
<td>gravitation</td>
<td>wing of a bird</td>
</tr>
<tr>
<td>ground / gravitation</td>
<td>tree, skeleton</td>
</tr>
<tr>
<td></td>
<td>leg, foot</td>
</tr>
<tr>
<td>electromagnetic waves</td>
<td>senses:</td>
</tr>
<tr>
<td>acoustic waves</td>
<td>eye: color, bright, dark</td>
</tr>
<tr>
<td>chemical substances</td>
<td>ear: loudness, height of sounds</td>
</tr>
<tr>
<td>solids</td>
<td>nose, tongue: smell</td>
</tr>
<tr>
<td>movement of molecules</td>
<td>sense of touch</td>
</tr>
<tr>
<td></td>
<td>sense of temperature</td>
</tr>
</tbody>
</table>

| change of objects               | perceptive-cognitive framework of cat. / hypotheses of human thinking as functions of the human brain: |
| regular simultaneous coincidence, similarity regular “succeeous” coincidence of features, temporal sequence spatial extension | category of time category of analogy, induction, gestalt perception disposition to association, to acquire conditional reflexes (post), category of causality (propter) category of space |

| micro/macrocosmic object social construct | no evolutionary answer, no selected cognitive strategy, mistakes in human knowledge |
5 EE 5 --- 5.1 EE’s evolutionary ‘mirror’ 2

Evolutionary Epistemology
(dtv-Atlas Philosophie, 1991, 188)
5 EE 6 --- 5.1 EE’s evolutionary ‘mirror’ 2

Aprioristic cognitive conditions (read from bottom to top)
(Oeser, Psychozoikum, 1987, 188)
5 Evolutionary epistemology 7

5.2 EE: reliability of human cognition; cognitive strategies selected by evolution

On the one hand, cognition is reliable:

Nature can be “calculated”, cognition is reliable and objects of cognition can be well understood in those areas only where cognitive strategies are necessary for survival, were selected/produced during evolution, are therefore adequate: “Mesocosm” (Gerhard Vollmer)

Proved strategies correspond to (mirrored) qualities of W1.

Otherwise:
“Humans would be completely confused and lose their ways.”
“ein ratloses Tappen in völliger Verwirrung”
(Riedl, Biology of cognition, 1979, 186)

On the other hand, cognition is not reliable:

Nature can scarcely be “calculated” and objects of cognition can scarcely be understood in those areas where cognitive strategies are not necessary for survival, were not selected during evolution, are not adequate: “Micro- / Macrosom”

“The nonsense of prejudice always starts at the boundary of the area of selection.”
(Riedl, Biology of cognition, 1979, 186)
5 Evolutionary epistemology

5.2 EE: reliability of human cognition; cognitive strategies selected by evolution

Mesocosm (Oeser, Psychozoikum, 1987, 17)
5 Evolutionary epistemology 8a

5.2 EE: reliability of human cognition; cognitive strategies selected by evolution 2a

Rupert Riedl’s illustration in Die Ordnung des Lebendigen. Systembedingungen der Evolution, 1975, is adapted from Camille Flammarion (1842-1925): L’atmosphère, météorologie populaire, Paris 1888, p. 163
5 Evolutionary epistemology

5.3 EE: the 1st epistemological dilemma

The set / system of categories
(cognitive equipment / apparatus, “Weltbildapparat”)

– makes objects of indirect cognition accessible to human experience
– is the only way of human cognitive access to reality
– does not explain objects of indirect cognition
– does not develop isomorphous models, but functional models
– restricts the liberty of thoughts to a certain degree (framework)
– is not complete: perception is missing for lots of real categories
– must not be dogmatically considered as absolute, but as approximative

Kant’s categories are innate hypotheses developed by evolution
→ all human knowledge is a collection of hypotheses
→ Popper’s theorem of falsification
5 Evolutionary epistemology 10 --- 5.4 EE’s profit

1. **Estimation of the degree of distortion**
   not too big, depending on the object domain;
   consequence: approximative knowledge
   with different quality is possible
Motivation: the human sensory-mental apparatus
   for the production of world images
   is a result of selective evolution,
   its reliable function in mesocosm is necessary for survival,
   its reliable function in micro / macrocosm is not.

2. **Explanation of epistemologically wrong judgments**
   Cognitive strategies (naive realistic)
   acquired during evolution
   for simple primary cognitive situations
   (in Younger Stone Age, Neolithic period)
   are transferred to complex secondary cognitive situations
   (scientific exactness in microcosm and macrocosm)
   because of too vague knowledge
   of fundamental epistemological problem complexes:
   divergence of biological and technical-cultural evolution

3. **Profit for information systems: counter-measures**
   Considerable reduction of the undesired consequences
   of fundamental epistemological problem complexes
   can be achieved by
   systematically recognizing them and
   consciously dealing with them.

   There is no general ‘recipe’ for perfect models,
   EE does not lead to new modeling techniques
   as the principal epistemological problems cannot be removed
   by any modeling method!
6 Epistemological step model 1

No epistemological approach is able to adequately cope with every object and situation of cognition.

The adequacy of an epistemological approach depends on the regarded object of cognition.

Therefore, we need an epistemological step model spanning the spectrum from naïve realism to hard constructivism.

The constructed parts of human knowledge with regard to – particular objects of cognition and – particular epistemological approaches show a parallelism which leads to the epistemological step model.
6 Epistemological step model 2

(Holl / Maydt, Epistemological foundations of RE, 2007, 47)

(Holl / Maydt, Epistemological foundations of RE, 2007, 48)
6 Epistemological step model 3

In the concrete case of a given object of cognition, the simplest adequate approach has to be chosen.

<table>
<thead>
<tr>
<th>Relation reality – model</th>
<th>Epistemological approach</th>
<th>Scope in a step / layer model</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 1</td>
<td>naive realism</td>
<td>simple objects in the physical world</td>
</tr>
<tr>
<td>a certain</td>
<td>critical realism, moderate constructivism</td>
<td>complex objects, optical illusions, sub-atomic particles, enterprises, economy, human society</td>
</tr>
<tr>
<td></td>
<td>evolutionary epistemology</td>
<td>special explanatory value</td>
</tr>
<tr>
<td>no</td>
<td>radical constructivism</td>
<td>speculations, psychiatry</td>
</tr>
</tbody>
</table>

The discrete step model can be replaced by a **continuous model**. As the boundaries between the steps are not hard, this model with **discrete** steps can also be interpreted as a model with a **continuous** inclined plane.

**Remark**
The same idea applies for human **free will**.
It depends on the **object of the will**, on the situation:
– rational objects: conscious, responsible decisions are possible
– everyday situations which require quick decisions:
  influence possible, often not necessary
– emotional objects: influence is nearly impossible
7 Summary: ubiquitous constructivism

Every (re-)construction (interpretation) of reality is determined by biological and social norms of perception and, therefore, always contains some constructed part. Example: color blindness

The size of the constructed part can only be determined relatively.

(Holl / Maydt, Epistemological foundations of RE, 2007, 47)
8 References

pdf-files of my own publications: see my homepage.

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