Natural and Social Sciences: Similarities and Differences

Prejudices of a Natural Scientist

Dezső Boda

Department of Physical Chemistry
University of Pannonia

boda@almos.vein.hu

Kőszeg, 2015.10.13.
What is the goal of research? Similarities.

<table>
<thead>
<tr>
<th>Natural Sciences</th>
<th>Social Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding phenomena</td>
<td>Understanding phenomena</td>
</tr>
<tr>
<td>Making prediction</td>
<td>Making prediction</td>
</tr>
<tr>
<td>Pillars: Logic and observation</td>
<td>Pillars: Logic and observation</td>
</tr>
<tr>
<td>Studying what and why</td>
<td>Studying what and why</td>
</tr>
<tr>
<td>Looking for generalities</td>
<td>Looking for generalities</td>
</tr>
<tr>
<td>Looking for patterns</td>
<td>Looking for patterns</td>
</tr>
<tr>
<td>Establish relations between variables</td>
<td>Establish relations between variables</td>
</tr>
</tbody>
</table>
Similarities in methodology – the Wheel of Science

**Figure 1-3**
The Wheel of Science. The theory and research cycle can be compared to a relay race; although all participants do not necessarily start or stop at the same point, they share a common goal—to describe and explain all human sociocultural phenomena.


We study different things

Study of János Abonyi on the basis of Scopus database
## Differences

### Different approaches to numbers: Qualitative vs. Quantitative

<table>
<thead>
<tr>
<th>Natural Sciences</th>
<th>Social Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Discussion</strong> usually involves math (notable exceptions: descriptive sciences, biology, etc)</td>
<td><strong>Discussion</strong> is often verbal</td>
</tr>
<tr>
<td><strong>Variables</strong> denote well-defined things that are produced by either reproducible experiments or first-principle laws through mathematics</td>
<td><strong>Variables</strong> are taken from databases (Big Data), questionnaires, or polls. Observation is less of a problem.</td>
</tr>
<tr>
<td><strong>Hunt</strong> for basic laws that explain the relations between variables</td>
<td><strong>Hunt</strong> for patterns that indicate correlations between the variables</td>
</tr>
<tr>
<td><strong>Challenge:</strong> find basic laws that can explain phenomena in realms hard to observe (micro, galactic)</td>
<td><strong>Challenge:</strong> find basic laws that can explain these correlations</td>
</tr>
</tbody>
</table>

„Only a few sociologists would openly deny the logic of combining the strengths of both quantitative and qualitative methods in social research. . . . In practice, however, despite such wider methodological aspirations in principle, social researchers have regrettably become increasingly divided into two camps, many of whose members know little of each other even if they are not explicitly hostile.”

The problem of reproducibility

Different approaches to modeling: What are the variables?

**Natural Sciences**
- Models are simplifications – we cannot take everything into account.
- We neglect unimportant things.
- Example: when we describe the orbit of a falling apple, we do not include the worm in the apple in the model.
- The main question: What is important? It is usually not so obvious.
- Studying the model: using basic laws and theories developed on the basis of them.

**Social Sciences**
- Variables are sets of attributes, categories, values (yes or no, male or female, numbers, etc.).
- Model: logical generalizations on the basis of observed patterns from which principles can be developed and predictions can be made.
- Understanding comes through the model.
- If the model is successful and very general, it is called a paradigm.
Different approaches to presenting results

**Natural Sciences**
- More data, less discussion – the data speak for themselves
- Rigorous structure of scientific papers: introduction, methodology, results, discussion, conclusion
- Extensive references to others (it is a requirement): it is rare that nobody else did something similar
- Graphs rather than tables
- Slideshows with carefully chosen sets of results that make the point
- Establish the „point” at the beginning
- Efforts to be concise

**Social Sciences**
- More discussion – data are not always available
- Papers are often essays and analyses
- Presentation: reading of the text (a cultural shock for me)
- Lack of conciseness: things are complex so they need to be expounded
Different approaches to „Agency” and the „Politically Correct”

The Human Side of Research

- Agency: the capacity of individuals to act independently and to make their own free choices
- Social Sciences are about Humans – feelings can be hurt by the results (not really a problem in Natural Sciences)
- Results can change the studied object – a Strange Loop
- More space for Opinion Terrorists (PC)
- Events that you are blacklisted by scientific authorities (even if you are right) is quite rare in Natural Sciences.
- Is there a fear from Opinion Terrorists? Is that the reason of careful wording, blurred discussions, lack of to-the-point statements?
## Similar hierarchy: Microworld vs. Macroworld

### Natural Sciences
- Microscopic (molecular) level: molecules buzzing around
- Their motion can be described with classical (Newton) or quantum (Schrödinger) mechanics
- The zillions of microscopic events average out into a macroscopic answer that can be measured (thermodynamics)
- The link between the two level is described by statistical mechanics (first-principle)

### Social Sciences
- „Microtheory deals with issues of social life at the level of individuals and small groups.” (psychology, social psychology, microsociology, etc.)
- „Macrotheory deals with large, aggregate entities of society or even whole societies.” (macrosociology, history, etc.)
- What is the link between them? Can a law (similarly to stat. mech.) be developed?
# Applicability of a mechanism that decreases Entropy: Evolution – Genes vs. Memes

## Natural Sciences
- **Replicator:** the gene
- Genes code organs, bodies, instinctive behavior
- Organisms carry the replicator
- Fit genes make the organism survive and multiple thus passing the gene to future generations
- Creates more and more complex (ordered) organisms that are better and better in adapting to the environment
- Fight against the 2nd Law of Thermodynamics

## Social Sciences
- **Replicator:** the meme
- Memes code everything beyond genetic coding
- Human brains carry the replicator
- Fit memes make the Humans remember the meme and pass to other Humans thus multiply the meme
- Creates more and more complex ideas, cultures that make Humans better in surviving (for example: Science)
**Summary**

### Similarities

- **Goal of research:** understanding and making predictions
- **The World is ordered.** What is the nature of this order? How does this order emerge from Chaos? Religions have a different answer.
- **World is structured and hierarchical.** See: micro and macro levels.
- **Search for patterns and regularities** (quantitatively if possible)
- **Both use deterministic and probabilistic approaches**

### Differences

- **Relation to math vs. relation to verbal discussion**
- **Meaning of variables:** numbers vs. attributes
- **Existence of a few first-principle laws vs. existence of many patterns**
- **Different meaning of models** (simplification is common)
- **Different degree of reproducibility of results**
- **Different ways of discussion, publication, and presentation**
- **Different approach to „Agency”**