

# The Epistemological Foundations of Scientific Knowledge

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When the truth is found  
to be a lie,  
some sociologist  
may be around.

## **Abstract:**

The text basically tries to make five points:

All kinds of science share the same epistemological foundations.

Science is not a search for (absolute) truth, but one for (situated) knowledge.

Objectivity only is ever *interpretive* objectivity.

A version of *Pragmatism* can best answer all epistemological questions.

This particular Pragmatism has to be thought of as *relational*.

## **Introduction**

With their research, scientists want to *produce* knowledge. Therefore, knowledge is not found “out there” in the world, but rather is produced by human beings. And this is even true of the sense data our knowledge is based on. The first step in “gathering” data is to identify something as something. Things do not have signs on them that indicate what they are. We make use of language and other symbolic systems to assign a name and meaning to things. Just looking at the world is already a kind of interpretation. Even in natural sciences researchers constantly have to interpret sense impressions, symbols and theories. And, of course, reading articles also involves interpretation and understanding. Considering this, it will become clear that there are no epistemological differences between natural sciences and humanities, although their methodology slightly differs, as does of course the object of research – a natural world without meaning vs. a human world full of meaning. To see the difference this way is a result of the process of disenchantment of the world that has been very powerful, especially in Europe. It began with the absolute transcendence of the only god, went on with the rationalization of religion focusing on belief and ethical practice (instead of ritual practices), and an ever stronger interest in the ways of this world (immanence) and culminated in the centrality of the individual human being and her/his relation with the world (and god, at least for some).

### Differences and similarities of the various sciences

|                    | Natural sciences                                   | Humanities   | Social sciences                               |
|--------------------|--|--|---|
| Object of research | Nature   | Longer lasting products of human beings            | Human beings living together                  |
| – material         | Clouds, mountains, planets, atoms, plants, animals | Goods, art, texts, buildings                       | Activities, actions, bodily contact           |
| – immaterial       | Causal connections and interrelations              | Structural connections, meaning (ideas and values) | Interpretations, norms, rules and regulations |

As a human, (social) activity science *takes place in* a cultural setting. On the other hand, science *contributes to* culture. Especially since the differentiation of several social fields (religion, politics, economy, law, science etc.), with their different core ideas and values, science can also be seen *as* (part of) culture (Daston 1998). This can be seen in the centrality of the value of objectivity which developed with the shift from the religious idea of a holy cosmos to the secular one of a world order that can be known. As rational beings, humans then have the capacity to strive for objective knowledge (cf. discussion in part IV).

Three things can be noticed here:

1. If objectivity has a history, this is a strong hint to the fact that cultural and social processes of *construction* play an important role in the human search for knowledge.
2. Accordingly, one should think less of *objective* data and more so of *objectified* data, being the result of research processes.
3. This also shows that it was/is a mistake to tear the subjective and the objective sphere apart. The important task is to describe their *relationship*. (/the relation between the two).

Therefore, the most important questions are:

What can we know?

How is knowledge produced?

Which kinds of philosophical claims are made, either explicitly or implicitly?

What is the relevance of the thesis that objectivity is not possible?

They are answered in a general manner, including all branches of science, which of course differ in certain aspects.

The major insight of our discussion will be that it makes good sense and is possible to overcome epistemic dualities like subjective/objective, empiricism/constructivism or deduction/induction. And this pertains to the philosophy of science in general. Although there are some differences between the main branches of science, they have to deal with the same epistemological problems for which a very similar solution can be provided.

## Concepts

If the task is to think about the preconditions and presuppositions of scientific research, it helps to first give some conceptual clarifications.

## What is science?

The word ‘science’ itself is used as a general name for, on the one hand, the procedures of science – adventures of thought and stratagems of inquiry that go into the advancement of learning – and on the other hand, the substantial body of knowledge that is the outcome of this complex endeavor, though this latter is no mere pile of information. Science is organized knowledge [...]. (Medawar 1984: 3)

The last point refers to the truth that it is not the sheer increase of the quantity of knowledge that scientists are after, but the relations between certain things and insights, as well as some kind of systematic order.

The first point refers to science as having certain procedures; one could also say: methods.

In common usage, one quite often finds mere *belief* contrasted with *justified belief*.

To not just believe something implies having a *critical attitude*. Instead, one has to give good *reasons* for one’s belief and should never stop *evaluating* claims and theories (Tibbetts 2013: 5-20). Following this, one gets justified knowledge – at least for some time. As research goes on, knowledge will change.

If we understand science as “the systematic pursuit of knowledge” we are confronted with the philosophical questions of “what kind of things exist and how we can know them” (Williams/May 1996: 45). The first question refers to ontology, the second one to epistemology. Methodology tries to find the method that is apt for various ontological or epistemological claims.

|                     |  |
|---------------------|--|
| <b>Ontology</b>     | deals with the essential nature of the world – <i>what there is</i>                        |
| <b>Epistemology</b> | deals with the scope and reliability of human knowledge – <i>what we can know for sure</i> |
| <b>Method</b>       | the practical techniques of research – <i>how we come to know</i>                          |

It is important to state that the use of a method (doing something in a systematic way) gives no guarantee for a correct outcome. There can also be something like a *systematic error* produced by, or in spite of, certain procedures. One can try to minimize it, but epistemological reasons for its presence still have to be given.

## What is research?

In a common sense perspective, people imagine scientific research to be about the discovery of something in the world or about the world. But here a lot of philosophical questions come up (and all of them have been hotly discussed in the past centuries): Do we have direct access to “the world” and if so, how reliable and far reaching is what we perceive (“find”)? If we only have indirect access due to whatever reasons, how can we claim to have acquired knowledge of the world?

In the next sections we will deal with some of the most relevant points of these discussions. We will find that indeed researchers do not passively receive sense data, but actively make selections that are stipulated by various factors (Williams/May 1996: 19).

## Reality and Human Knowledge

Human beings live in a distinct world. Their ability to see and hear is limited to a certain spectrum and frequency. Their worldview, therefore, differs from that of animals, birds or insects on

the one hand. On the other hand, even for humans there is no fixed way to name colors from the spectrum or to organize a system of tonality. It is not a necessity to distinguish orange in the range between yellow and red. Accordingly, anthropologists have encountered cultures where there is no distinction made between blue and green. Although their world may look different, we are still not entitled to claim that their world is *totally different*, as a *relativist* position would like to have it. Certain differences do not impede the possibility of having a lot of things *in common*.

Nevertheless, the above mentioned examples show that a distinction has to be made between the way the world *really* is and the way human beings from different cultures see and categorize it. Then the important and difficult question is how much their concepts and “theories” grasp reality. A lot of disparate views have been proposed on this and the whole discussion is best understood if one takes a short look at the history of philosophy.

In Greek antiquity, some philosophers discovered the power of language and rhetoric. Arguing against these Sophists, Socrates and Plato developed the theory of ideas. For everything in the world or any topic one can discuss there is such a pure idea. What we encounter in our everyday world is only a pale image of the ideas. It is ideas that have the highest and truest reality. But, in this way the world is doubled, remarked Aristoteles, the famous student of Plato. He tried to show that somehow the ideas are in the things as a kind of potentiality for further development.

Christian thought in the beginning was mainly influenced by Neo-Platonism (Camus 1936/65) and only later was Aristoteles reintroduced via retranslations from Arabian editions. Then once again the old discussion came up; whether that which concepts refer to does exist as a reality (*realists*), or whether human concepts are only a convenient name (*nominalists*). In this heated debate, claims about *existence* (ontology) and claims about *truth* (epistemology) have been mixed. Additionally, it was a very abstract discussion in *speculative philosophy* that came into conflict with *theological dogmatism*. One reaction to all this was the development of the principles of *scientific reasoning* based on systematic observation from the 15<sup>th</sup> century onwards – first and foremost in astronomy.

At the same time, and as a consequence of protestant reformation, theological dogma lost some of its hold over the mind of people who have been encouraged to read the Bible themselves. God was more and more seen as the creator only, who then stepped back from his creation (Deism). This left the world in the hand of man/(men!). Whereas before the world was thought to have a *moral* order (*cosmos*) and it was idle to enquire about gods creation, now the world was seen to have a *rational* order (Hooykaas 1973). This idea was very influential in social philosophy as well (cosmopolis, natural law, rational religion). By this time a controversy developed between philosophers putting *rationality* at the top and those who deemed sensual *experiences* to be the foundation of all knowledge (rationalism vs empiricism).

Since then we have been able to distinguish between contrasting models to think about our knowledge of the world.

First, there are two ways to explain philosophically how our knowledge of the world is generated. They stand in opposition to each other in every respect.

| <b>Empiricism</b>               | <b>Rationalism</b>       |
|---------------------------------|--------------------------|
| Sensual experience of the world | Thinking the world       |
| Things in the centre            | Human mind in the centre |
| Seeing like in a mirror         | Giving form              |
| Making abstractions             | Provide constructions    |
| Concepts                        | Concepts                 |
| Correspondence                  | Coherence                |
| Objective truth                 | Logical truth            |
| Naïve Realism                   | Proved Realism           |

Of course this is very much typified but in the history of philosophy most of these features have been proposed together. On the other hand, a lot of questions have been brought forward against such a simplistic and dualistic mode of thinking.

For more than a hundred years there has now been a third position, which takes insights from both the others.

| <b>Pragmatism</b>                |
|----------------------------------|
| Practices in the world           |
| Handling of things in the centre |
| Working with (and on) forms      |
| Testing constructions            |
| Concepts                         |
| Success                          |
| Practical truth                  |
| Critical Realism                 |

We may notice in this view back into history that in all these instances two contrary positions have been set up against each other. Thinking in those either/or dichotomies is very limiting. Often both propositions can be meaningful somehow and even at the same time.

Let's try to sort things out by taking up the distinction between ontological and epistemological claims. According to the first, the world and all the things in the world are either there in and as reality or not. As only a few persons deny the existence of the world independent of our thinking of it (George Berkeley, Indian *Samkhya* philosophers) we are left with the second question concerning the value of our thought about the world. Here again it may be useful to distinguish between theoretical entities and theories about those entities (Hacking 1983: 27). As there can be different theories on particles, processes or structures, again the question of their reality has two layers. Are the entities real, but the theories not? We may think of the sun, earth and moon as real, but not so much of the Ptolemaic system or Copernicus' theory. Or, are the entities real in an *existential* sense, because we can use them in experimental work, and the theories in an *epistemological* sense, since they can be either true or false? Ian Hacking opts for this second possibility, proposing "a drift away from representing towards intervening" (29). Here the above mentioned *pragmatism* may be of great help.

## Striving for Knowledge

The conclusion of the last section has been that it leads nowhere to doubt the existence of the real world, but also that we cannot somehow *naively* assume that objective knowledge is possible.

There are strong reasons to be *critical* towards our capacity for knowledge acquisition. What exactly then is the knowledge possible for us to reach and how do we get it?

Let us begin with the simple question: *What do we know?*

Two rather *extreme* answers are possible: *Everything!* That is a very bold claim, and usually all-embracing knowledge is granted to god only. *Nothing!* A very unrealistic answer.

Two more *moderate* answers would be: *Enough!* It is not very probable that we can know this for sure; only strongly religious people might say so. *Not enough yet!* This leads to the next question: How do we get to know more? Of course, one way is learning (from teachers, from books), and the other research.

### How is knowledge produced in research?

In the history of philosophy two ways of reaching conclusions have been named: *deduction* and *induction*. In *deduction* you start from a given general sentence or hypothesis and try to make explicit what is logically included in it. You draw the *logical conclusion*. In science, it is said that you can specify in this way the individual case and the experimental conditions which could prove the sentence. In *induction* you move from the specific cases to the general sentence or hypothesis. You draw a *hypothetical conclusion*. Doubts have been brought forward whether science really proceeds with these syllogisms. Deduction alone tells us nothing about the origin of general sentences and David Hume (1711 - 76) pointed out that we are not rationally entitled to draw an inductive conclusion. From a limited number of observations you cannot easily proceed to a general sentence, and even the fact that in the past it was valid does not make it probable for the future, as the future is unknown.

One answer to this problem was given by Karl Popper (1902 - 94). He claimed that if Hume is right, then no theory can be *verified*, but only *falsified*. He even refuted the idea of probability and spoke of the degree of corroboration instead. Knowledge is based on conjectures that either are refuted or stand the test. Even then it is only preliminary and we can only justify the preference for one thesis or theory instead of others because it stands critical discussion.

One may wonder why negative evidence has the power to refute a statement or theory, while positive evidence cannot confirm it. The testing of theories is confronted with the same problems of infinite number and the time frame, like induction is. If verification is an unjustifiable claim, the same is true for falsification. This led philosophers of science to point out that any theory is defended by those who hold it as a *paradigm* (Thomas Kuhn) or that there is a *core* of the theory which is surrounded by statements which are more easily given up in the face of contradictory evidence (Imre Lakatos). Thus, it can be said that a *new* paradigm is never absolutely new. To gain credibility it must be seen to reorder the *familiar* in a plausible way. Any change, and even a revolutionary one, rests on some kind of continuity (cf. Barnes 1982).

It is also very useful to distinguish between the process of discovery and the process of justification. Looking at scientific practice shows that even in discovery we do not start our research from observations, but from ideas, hypotheses or theories. Then we try to see whether they stand the empirical test or if we have to adjust them. But where do our ideas or hypotheses come from? Usually they are based on earlier ideas and observations and their discussion. We can no longer determine which came first. They are interrelated in a long process (cf. hen or egg). Nevertheless, it makes sense to refer to Charles S. Peirce (1839 - 1914) here, who named *abduction* the *creative conclusion* which introduces something new (cf. Reichertz 2010). Likewise, Carl Hempel (1905 -

97) saw that “the transition from data to hypotheses requires creative imagination” (Nola/Sankey 2014: 23). Therefore, we can say that abduction provides the idea for a hypothesis, deduction tells you where to look, and induction gives you a hint as to whether you were wrong or not.

## The Possibility of Objective Knowledge

Science proceeds by making use of explicitly defined and precise concepts to formulate connections between statements and theses that should stand in a clear relation to observations and their interpretation. The guiding idea is no longer truth, but a kind of objectivity. First we have to explain this difference, and then discuss what we mean by objectivity.

There is a difference between *factual* objectivity in the sense of absolute accordance with the way the object of research is, and *interpretive* objectivity that is based on a certain perspective. Trying to be true to the facts is part of the metaphysical idea of truth, and to reach it a *view from nowhere* would be required, which is impossible to attain. We can only strive for a kind of objectivity that is based on a *view from somewhere*. And this is allegedly *relativistic* only when measured against *absolute* truth (which is much more a religious idea than a philosophical or scientific one).

If objectivity is related to a certain perspective, again questions of validity of knowledge come up. There are various understandings of objectivity that all try to answer these questions somehow.

First of all, objectivity is a specific *attitude and virtue*: “Objectivity requires us to stand back from our perceptions, our beliefs and opinions, to reflect on them, and subject them to a particular kind of scrutiny and judgement. Above all, it requires a degree of indifference in judging that may conflict with our needs and desires.” (Gaukroger 2012: 1)

Besides that, there are three different *concepts* of objectivity (following Stephen Gaukroger):

- 1) Objectivity of judgement, which either requires us to remove bias and prejudice (a reasonable precondition only), or to remove all assumptions (impossible).
- 2) Objectivity as the result of procedures (a condition only, not a definition).
- 3) Objectivity as accurate representation (is in need of a criterion of judgement).

Lorraine Daston and Peter Galison traced the idea of objectivity as accurate representation through the last four centuries (2007). They found that the ideal of representation moved from the idea of depiction of the *essence* beyond appearances, and then the *mechanical* reproduction of what appears, over *abstraction* from any pictorial representations to the *trained judgement* of representations. This is not so much about the elimination of prejudice, but more about the elimination of arbitrary judgements. This way, in the end we find that “objectivity is something that can be learned and improved upon through practice” (Gaukroger 2012: 65).

Therefore, some degree of objectivity may be reached not by ignoring the cognizing subject, but by making use of it. Making explicit any reasoning or judgement can lead to justification of theses and theories which aim to represent reality. This is in accordance with the epistemological claims of *critical realism* which acknowledges that we cannot reach objective or absolute truth, but have to be content with the more modest aim of reaching objective *interpretations*.

All this being said, we can leave the metaphysical idea of truth and objectivity behind and stick to objectivity as a value, which can be attained by reaching our interpretations by making use of specified procedures.

### Different aspects of objectivity

|                 |              |
|-----------------|--------------|
| Ontological     | Factual      |
| Epistemological | Interpretive |
| Methodological  | Procedure    |
| Ethical         | Value        |

Nowadays, objectivity is an epistemological problem only and no longer thought of as a metaphysical state.

## The Social Construction of Knowledge

As could be seen, to be objective is an imperative norm; objectivity, therefore, is a value. This way, even a “value neutral science” is based on certain values (Max Weber). On the other hand, strict neutrality is not possible in science, because after all it is conducted by human beings and not machines or robots (only). Scientists are not only scientists, but ordinary men and women as well. Therefore, we have to look more closely at who the scientist is.

In general, but in science as well, the individual *cognizing subject* comes into being in her/his biographic history. Everybody grows up in a particular culture and society. In the long course of childhood everyone develops the basic human competences of purposive action and of communication with the help of symbolic systems, with language being the most important one. Even more fundamental is the development of a view of the world that at least helps us to survive. As we already saw, in the seventeenth century a heated philosophical debate took place on the priority of either sensual experiences or rational capacities in the making and ordering of knowledge of the world (cf. Gaukroger 2016, Chapter 1). Today we can say that neither blank *experience* nor sheer *rationality* rank higher herein. They develop *together* in social practice. Every new born child interacts with adult others who already apply categories and concepts in interaction. In this way, experience is pre-structured for the child, which in turn enables the development of ideas to order sense data (which are in fact results of processes in the brain) into experience and make use of concepts to interpret the world.<sup>2</sup> As we all know, this takes several years and even then the process goes on. Therefore, the subject is less a self-identical entity, and rather a product in the making. It is *subjected* to specific conditions under which it can (in various degrees) become *subject of* its life and worldview. Richard Rorty (1931 - 2007) correctly pointed out that self, society and language are contingent (not so out of necessity) and can be otherwise. On the one hand, this is a major cause of why we can learn and acquire knowledge. On the other hand, it seems to devalue all knowledge as being *relativistic* only. However, this presupposes the possibility of *absolute* knowledge, that for a long time in European history was there, either as a truth based on the essence of things in Antiquity or as god-given certitude in Christianity. But, even knowledge that is relative to a specific time, place, language or social community can have a particular liability, because one always has to give good reasons to doubt it. Nevertheless, the stronger the idea became of the subject as an active individual self, the more it seemed to be necessary to control it and so enable the selfless pursuit of objectivity. The skepticism about the cognizing subject

since the seventeenth century has led philosophers to strictly oppose subjectivity with objectivity. According to the idea of modern science, “subjectivity [has to be subjugated] to objectivity, the personal to the methodically mechanical, the individual to the institutional, the contingent and the spontaneous to the rule of rule” (Shapin 2008: 3). But, astonishingly, describing the conditions of knowledge production we find: “The closer you get to the heart of technoscience, and the closer you get to the scenes in which technoscientific futures are made, the greater is the acknowledged role of the personal, the familiar, and even the charismatic.” [Steven Shapin] shows “how it is that personal virtue, familiarity, and charisma feature in such characteristically late modern configurations as the industrial research laboratory and the entrepreneurial network.” (5) Whereas the ideal of science is to “eliminate all bias of personality,” (6) the creative personality and the authority of the scientist still matter a lot. Being a scientist is not only a job in some institution where the “regulative ideal of disinterested inquiry” (19) rules. Scientists are human beings with all their virtues or lack of them. Of course, one of their most important features is their trained competence. All in all, one is entitled to say: “The knowing self is a precondition for knowledge, not an obstacle to it.” (Daston/Galison 2007: 53)

Now and then we have already hinted at the fact that it is very seldom the individual subject alone who strives for knowledge, but who does so together with others in a group or team. They make use of symbolic forms that enable communication and which can carry meaning. Sociologist Herbert Blumer (1931) gave a somehow simplistic, but nevertheless useful description of what concepts are. “They are not items of direct perceptual experience; they have originated as conceptions from direct perceptual experiences which have been puzzling and problematic. They serve to introduce order or intelligibility into such experiences.” [...] “As a form of conceiving the concept liberates frustrated activity and enables new action.” [...] “Without concepts, activity would be tied to a given perceptual level with scarce opportunity of reaching a higher perceptual plane.” (519) Concepts are based on a kind of abstraction from particulars, which in turn makes possible that “(1) this content may become object of separate investigation and reflection, (2) it may enter into the experience of others and so become common property.” (520) “By reason of its verbal or symbolic character, the concept may become an item of social discourse” (522). Later, Blumer specified that the meaning of things (the concepts) “arises out of social interaction that one has with ones fellows” (1969: 2). These meanings are modified through an interpretive process by the person in dealing with the things. “Interpretation should not be regarded as a mere automatic application of established meanings but as a formative process in which meanings are used and revised as instruments for the guidance and formation of action. It is necessary to see that meanings play their part in action through a process of self-interaction.” (5) “From the standpoint of symbolic interactionism human group life is a process in which objects are being created, affirmed, transformed, and cast aside. The life and action of people necessarily change in line with the changes taking place in their world of objects.” (12) This makes perfectly clear the extent to which neither the objects nor the subjects of knowledge (in an everyday as well as scientific sense) are something stable and permanently given. They stand in *relation* to each other and change continuously. What then (can be said) of the possibility of knowledge?

Donald Davidson (1917 - 2003), one of the 20<sup>th</sup> century’s most important philosophers, provided an answer to this question. He proceeded from philosophy of mind to externalism, claiming “that the contents of a person’s propositional attitudes are partly determined by factors outside the mind (1991: 196), and he identified these as the *world* and the *other*, which is the reason why he spoke of perceptual and social *externalism* (197). He took “the objects of a belief to be the causes of that belief”. “If anything is systematically causing certain experiences (or verbal responses), that is what the thoughts and utterances are about.” (199) On the other hand, “the

identification of the objects of thought rests on a social basis.” When one person is observing the other the relevant objects are located in a *public* space. Davidson called this *triangulation* (201). Looking at a situation of teaching and learning makes this clear: “the learner is rewarded, whether deliberately or not, when the learner makes sounds or otherwise responds in ways the teacher finds appropriate in situations the teacher classes together. The learner is subsequently caused to make similar sounds by situations the learner instinctively classes together.” [...] “The teacher is responding to two things: the external situation and the responses of the learner. The learner is responding to two things: the external situation and the responses of the teacher.” (201) In this way, a *shared world* is created and the thoughts are tied to the world. People can feel entitled to claim *certainty* for their knowledge and develop the idea of *objectivity*, even if it is merely an interpretive one. All this is made possible by language and other symbolic forms.

Human beings have the specific ability to create something that represents something. These creations function as *symbols* that stand for something else. This can be the case not only for things, but also for ideas. After making representations (either simple or more complicated ones with the help of many symbols), we judge them “as real or unreal, true or false, faithful or unfaithful”. [...] Real is] “an attribute of representations” (Hacking 1983: 136). Seen this way, any representation is something public, not something in the head (132; cf. Geertz 1973: 10f.). Knowledge is as much *social* as it is individual. Moreover, its production is not through thinking only, but in *doing* as well. Representing is supplemented by *intervening*. Science is a *practice* after all.

What exactly do scientists do? They usually start with reading and thinking to devise a question or hypothesis, then go on with some kinds of observations, making use of certain techniques and methods. Those devices help to *objectify* some aspects, to bring about the objects of research in the first place. Working together, scientists obviously communicate a lot and in the end have to write a report or an article. Any such presentation of “findings” has a particular form, making use of stylistic elements and some rhetorical forms. If we observe what researchers do, we notice a lot of wasted time because of false starts (hypotheses and procedures), and many insights that come out of the blue or by chance. Therefore, science is not only about arranging a systematic order but also like trying to translate complexity into less complex arrangements.

As can be seen, knowledge is a social construction. Scientists work together or make use of socially established symbolic systems. This is the reason why we speak of the *scientific community*. The object of science is a social concern and it is subjected both to rational justification and rational critique. Therefore, we can speak of *collaborative empiricism* and *rational criticism* as well. Especially in the writings of Karl Popper the ideal of the rational actor was very prominent. It can even be claimed that the growing acceptance of the model of the rational actor was an important factor in the world-wide spread of science (Drori/Meyer/Ramirez/Schofer 2003). Although Popper would probably not agree, we can say that his critique of induction and verification led to a kind of *pragmatism*. Even if we cannot verify our claims, we hold on to them as long as they are useful in explaining and handling certain things and we look to the future with optimism that large portions of our knowledge constructions will stand the test of time (Rorty 1994).

As we have seen, knowledge is related to a certain perspective. This is an individual as well as a social one. In science there are additional aspects like the particular perspectives of schools, traditions, fields of research and paradigms. Finally, considering the production and circulation of knowledge, we always have to take into account uneven *power balances* between different genders and ethnicities, languages, and regions of the world. One important factor that contributes to

these imbalances is the unequal availability of financial resources.

Up to this point, we have traced different ideas about the cognizing subject moving from any individual to the scientific community.

### The epistemic subject in the history of philosophy

| Subject producing knowledge    | Proposed by                     |
|--------------------------------|---------------------------------|
| Rational Individual            | Plato; René Descartes           |
| Perceiving Individual          | John Locke; David Hume          |
| Transcendental Subject         | Immanuel Kant                   |
| World-Spirit                   | Georg W. F. Hegel               |
| Science as such                | Auguste Comte                   |
| Humanity                       | Charles Darwin                  |
| Society                        | Émile Durkheim                  |
| Logical Language               | Ludwig Wittgenstein (Tractatus) |
| Community Engaged in Discourse | Jürgen Habermas                 |
| Scientific Community           | Charles S. Peirce; Karl Popper  |

Of course, each of these thinkers made a good point; the task is to bring all the aspects together.

## Natural Sciences and Social Sciences

So far, we have seen that *all science* is rooted in *interpretation*. The most basic one is the *identification* of a given object, a date, a movement or the characteristic handling of an object that constitutes a specific action. Any observation is *theory-laden*, guided by *ideas*, and the data produced do not speak by themselves – they have to be *selected*, *arranged* and *interpreted* so that they can be related to theories or hypotheses. Considering this, the question of the certainty of our knowledge comes up again. It becomes clear that we are not trapped between either *absolute* or *relative* truth. Truth is always *partial* and we should stick to the goal of improving the currently accepted “truth”/knowledge. That an ideal never can be attained does not render it useless. (We still wash, even if there is no perfect state of cleanness.) Theories that describe the complexity of Nature must remain open to accommodate answers to questions we have not thought to ask yet. [...] Open-ended and provisional truth can be unnerving, but it is the best truth we have. (Tibbetts 2013: 147f.)

Taking seriously the insight that scientists proceed from a certain *position* and with a specific *viewpoint* does not discredit the results of scientific research. It only encourages us to *make explicit* the position and the viewpoint. “What we see and what we judge are dependent on various perceptual-cum-cognitive interpretations that we place on our observations.” (Gaukroger 2012: 39) Pointing out subjectivity just destroys the somehow naïve belief in objective truth. Nevertheless, we still can claim that in the process of research we can come closer to the *specific* reality at a certain time and place we conduct research on. This reality is always historically and socially constituted and constructed in practical interaction by the researchers involved. Our knowledge is only relative, albeit in multiple ways: it is relative to time and place, to language (on two levels – the ordinary language and scientific language), to the social position of a researcher, to her particular scientific biography, and to a scientific community. Are we not entitled to hope that one relativity is counterbalanced by the other ones?

Even if we cannot know for sure whether some idea or theory is true in a metaphysical sense, we can at least go on *as if* it were true and carefully register the outcome. If it works, that is one further hint that it does not stand in conflict with the way the world is. This way we gain *practical* truth at least. If it does not work, we have to modify our hypothesis or theory. With this we follow the reasoning of the pragmatists: It is not so much observations that correct our knowledge constructions, but our whole practice, including research. And, after all, this is a social endeavor. Sociology of knowledge and Science and Technology Studies must not be seen as discouraging, but can be seen as encouraging that together as a scientific community we can improve our knowledge.

### The different branches of science

“Science is intellectually demanding” and “the practice of science demands discipline” (Tibbetts 2013: 147). “The scientific method requires meticulous examination of experimental facts or observations and careful evaluation of hypotheses.” (146) Whereas this can be said for the *natural sciences*, with respect to the *social sciences* we have to deal with a specific difficulty. Experiments and inquiries in the natural sciences can be replicated if the same conditions apply. In the social sciences, studies are not replicable with the same meaning, because the conditions change constantly, as human beings go on to reconstruct the situation and to make new decisions. If one asks a person the same questions after a short time the answers might differ to a certain degree.

At a first and superficial glance *natural sciences* deal with the relations between things, while *social sciences* examine relations between concepts and their meanings. But, the picture is much more complicated, since here the relations between persons and those between individuals and things play a significant role too. On the other hand, we have seen that the relations between things are examined by persons standing in social relations who additionally make use of concepts. “The objective” is “a production of agreement in a practice of life, [... which] manifests differential relations of power and authority” (Hazelrigg 1986: 10).

To come to grips with the specificity of human social life, we have to find out what is going on and how this is working. Social life is not based on some mechanism or fixed laws, but on interpretations and decisions, and the task is to understand them. In the history of the *social sciences and the humanities* three different ways have been proposed to reach this aim. One can concentrate on *individuals' points of view*, on *cultural frameworks* or on *social practices*. In the first case, statements or texts which entail the view are analyzed. In the second the larger context of ideas, values and rules is of interest. The third way is to look at aspects of interaction like conversation, discourse, joint activities, and work. What all three ways have in common is that everything they examine is in some way made up of *symbols*. They are the basic forms for the construction of the human lifeworld and reality. Again, it is a *practice* that we need to analyze. This is another hint that a *pragmatist* reconstruction is the most promising. Accordingly, today the *relational* perspective in the social sciences is gaining ground (cf. Ritzer/Gindoff 1992; Mellor 2004: 4, 22).

### Perspectives of Social Theory

Seen from a logical point of view, three basic perspectives are possible which make different assumptions. Two of them stand in strict opposition to each other:

|                              | <b>Objectivism</b>  | <b>Subjectivism</b>   |
|------------------------------|---|---|
| <b>Epistemology</b>          | True knowledge of objective reality is possible                           | Knowledge is a subjective construction                                |
| <b>Ontology</b>              | Society is a reality <i>sui generis</i> , a functioning whole or a system | Society is an institution growing out of (rational) individual action |
| <b>Explanation of action</b> |   |   |
| - Level                      | Macro   | Micro   |
| - Methodological perspective | Holism: totality determines   | Individualism: intentions   |
| - Method                     | Causal or functional  | Interpretive  |

The third perspective can avoid these extreme positions because it combines the most valuable insights:

|                              | <b>Relationism</b>   |
|------------------------------|--|
| <b>Epistemology</b>          | Knowledge can claim to be realistic as far as it stands the test of practice |
| <b>Ontology</b>              | Society is real insofar it is realized in social action/relations            |
| <b>Explanation of action</b> |  |
| - Level                      | Meso   |
| - Methodological perspective | Relationism: dispositions and forms  |
| - Method                     | Social-historical, social-biographic   |

It is not surprising that the general epistemological insight, that *pragmatism* can provide solutions to most of the philosophical questions, is taken up in the social sciences and humanities as well. But still the idea of objectivism is strong because it is congruent with the naïve realist interpretations of everyday experience.

## Relevance for Research Projects

Our short discussion of epistemological topics has so far shown that it contributes to the reflexivity of research if one considers these aspects. First and foremost it has made clear what the final aim of research can only be – an interpretation connected with modest epistemological claims.

To admit that something is there as (part of) reality entails no claim of truth, as you can utter true or false sentences about it. “There is a rock. It is of granite.” This can be the case or not, even if a rock is there. Truth is not a quality of reality, but of our descriptions. Truth then means nothing else other than accordance with observable reality here and now and under specific conditions of observation. A rainbow *is not* true, but the sentence “There is a rainbow” *can be true* today for some observers, as it can be false tomorrow.<sup>3</sup> The world is *present* for us in the phenomena we perceive, but the phenomena do not *represent* the world, because any perception already is an interpretation, which is represented in *symbolic forms*. There are two important consequences of this:

1) a multiplicity of slightly *different interpretations* of the same world is possible (Worsley 1997;

Deutscher 2010).

2) The best we can do is reach an *interpretive objectivity*, which at the same time is the result of inter-subjectivity.

Every scientist on the one hand is part of the *scientific community*, but on the other hand s/he is also rooted in a *society*. Therefore, social influences from two sources are at work – at one time to a higher, the other time to a lesser degree.

Nearly any society today is differentiated into various spheres or *fields*.<sup>4</sup> This is the reason why the question of the transfer of knowledge from the scientific field to other fields like politics, economy, culture or the legal field is of importance. And it may help to think of that transfer right from the beginning of the whole research process to make it more effective. According to Pierre Bourdieu, people and scientists are interested in different fields in varying degrees and they are differently equipped with competences and resources to deal with the forces working in those fields. Usually, for example, scientists are rather seldom able politicians.

Even in the sciences an increasing specialization has taken place, which is the reason why the results of research are no longer easily understood by a larger public. This again shows the necessity to think of the transfer of knowledge and/or make use of brokers (Pielke 2008). Together with growing specialization, some kind of *professionalization* has gone hand in hand. There are different organizations for scientists which further cooperation and set standards for good research. Of course science should be free and without bias (Scott 2019). Most research is evaluated by colleagues and publications are reviewed, which is how the scientific community works. Closely connected with this are some ethical questions that relate to the honesty of the researcher, her neutrality and “objectivity”.

If the aim of scientific inquiry is to produce knowledge, the question of its relevance always is important. But, whereas science rests on *methodological doubt*, in other spheres of life a solid conviction is needed to guide action. This brings to light that, at least in part, science is a *value in itself*. It makes a deeper look at more relevant aspects more possible than it is in everyday life.

## Conclusion

As it hopefully became clear in this short text, *all* sciences share the same epistemological problems and foundation. This may help in interdisciplinary understanding, even if the methods applied, the viewpoints taken and the objects studied differ to a minor or major degree. Exchange between knowledge systems is based on their “capacities to develop, to engage in self-criticism, to transform themselves in the pursuit of truth” (Connell 2010: 49) – even if we have to admit that it will only be partial truth, never the absolute truth.

If we accept that knowledge is a construction, how can we think of our constructions to somehow tell us about the way the world really is? Considering that the Latin word *factum* means “that which is made” should teach us epistemological modesty. Facts and knowledge are produced in everyday life and in science, and in scientific work aspects of everyday life (interaction, communication) play a significant role. Human beings can only *communicate* by making use of language and other *symbolic forms*. At the same time these forms are used to carry meaning and the *interpretation* of the world. One and the same cultural invention, therefore, helped man/woman to solve the epistemological problem and to enable social life. If we admit

that knowledge is a social construction, does that not mean at the same time that it is subjective and relative? The answer is both yes and no. Social has to be understood here as inter<sub>subjective</sub>. Accordingly, objectivity is an intersubjective construction *relative* to a certain time and place and out of particular interests. Such an interpretive objectivity is not the absolute truth, but if we can go on with it successfully, then it is a strong indicator that we are not too far off the mark.

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## Notes

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<sup>2</sup>Seeing something becomes “seeing as”. This means the connection of sense impressions with symbols (audible or visible) that carry meaning for us, e.g. words. Whereas in ordinary language (first order) words are used without explicit definition, in scientific language (second order) we try to use precisely defined concepts, because only they enable systematic comparisons across different contexts (cf. on this difference Blumer 1931: 522 - 25).

<sup>3</sup>Logical truth is a different problem that should not be mixed with truth according to reality under a particular perspective. A proposition is caused by a state of/in the world. “This rose is red” is true only when there is a *rose* and if it is *red* for everyone present (On truth cf. Engel 2002).

<sup>4</sup>Some call them *systems* also, but that presupposes a functionalist theory, which I think is a misleadingly narrow and administrative perspective of the social world (cf. objectivism).

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