Origins: Scientific claims

Until now I've talked about *statements*, *hypotheses* and '*explanations* of the world around us'. And I've used these general terms without specifying what they mean exactly. It's time to clarify this.

Scientific claims about the world around us can be categorized into different types. Some scientific claims describe or explain more phenomena than other claims. Also, some scientific claims provide more plausible descriptions or explanations of the world around us. We find some claims to be more certain, better supported by evidence, than others.

In *science* the most basic claim is an **observation**. An observation can be an accurate or inaccurate representation of the world. Suppose I observe that my cat, which has a ginger-colored coat weighs 6.5 kilograms.

Most scientists would accept this observation as a probably fairly accurate reflection of a specific aspect of the world around us, assuming the weight scale is valid and reliable. But in terms of explanatory power, they would find this observation very uninteresting, because an observation on it's own is not very informative; it doesn't describe a ***general relation between properties*** and it doesn't ***explain*** anything.

That doesn't mean observations are unimportant; Observations are the *building blocks* of the empirical sciences. But they're not very useful on their own. An observation on its own is the least interesting type of scientific claim since it has no explanatory power.

Observations become useful when they are used to confirm or contradict a **hypothesis**. A hypothesis is a statement that describes a *pattern* or *general relation* between *properties*. A hypothesis can also *explain* the pattern that it describes.

Take this hypothesis: ginger cats will on average be overweight more often than cats with a different color fur. And I could extend this hypothesis with an *explanation* for the relation between fur color and obesity, for example by stating that the genes for ginger fur color and signaling fullness of the stomach are linked.

The plausibility of a *hypothesis* can range from very uncertain to very certain. A hypothesis can be unsupported and therefore uncertain, for example if it's new and still untested. A hypothesis can also be strongly supported by many empirical studies and therefore more certain.

A special type of hypothesis is a **law**. Laws are very precise descriptions of relations or patterns; so precise that they are usually expressed as mathematical equations. They are also generally very well-substantiated; that's how they got so precise.

For example if I drop my cat's food bowl from a height of 56 meters and I know the

earth's gravitational constant, then I can predict very accurately how long it will take for the bowl to hit the ground, by using Newton's gravitational laws.

Laws allow for very precise predictions, but they usually don't *explain* the relationships they describe, in this case between distance, time and gravity.

Of course in the social sciences laws are hardly ever formulated. We understand too little of people and groups yet to be able to specify patterns in their behavior with such a degree of precision that we can postulate scientific laws.

Ok, so this leaves us with the term **theory**. In day-to-day life 'theory' means an unsubstantiated statement, an educated guess. In *science* however, 'theory' refers to a broad, overarching explanation of many related phenomena.

In the natural and behavioral sciences, a theory is built up out of hypotheses that are *very strongly supported by empirical evidence*.

In the social sciences, where *qualitative* and *historical comparative approaches* are more dominant, a theory is considered highly plausible when it has withstood attempts to refute it, based on logical grounds as well as historical or qualitative analysis.

So in science, theories are the most well-established explanations, the closest thing to certainty that we have, because they consist of hypotheses that have survived the scrutiny of the scientific method.

Of course this doesn't mean that scientific theories are certain or true. There have been many well-substantiated theories that were ultimately replaced, like Newton's mechanics that made way for the special theory of relativity. In science there is no certainty, only a provisional best explanation.