8. To what extent is certainty attainable?

Object 1: The Big Bang theory

As the first object of my exhibition, I chose the Big Bang theory. The Big Bang is a theory in science which explains the origin of our universe, as well as many physical, and chemical characteristics of the universe. The reason for my choice is my passion for physics (I study the subject at a higher level) and its ability to showcase the level of certainty attainable in natural sciences.

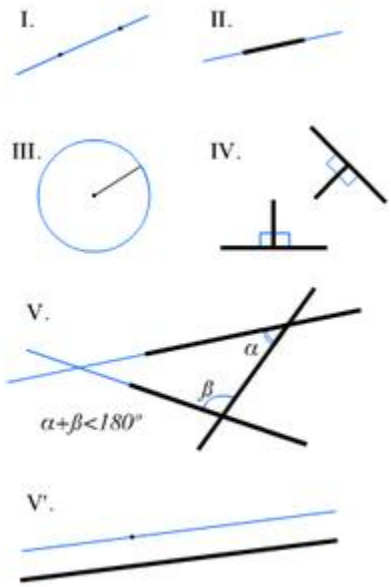
There is overwhelming evidence that supports this theory, confirmed and peer-reviewed by scientists all over the world. Examples of the evidence include our observations of the universe, such as the cosmic microwave background, and mathematically stated laws of physics, such as the Hubble–Lemaitre law[1]. The latter, due to its mathematical nature, is a deductive proof, which should provide an absolute degree of certainty. Alas, this is not the case, because purely deductive evidence is not sufficient to prove the Big Bang theory. Empirical evidence (such as the mentioned cosmic microwave background) is also necessary.

Nevertheless, all the evidence still proves the theory beyond reasonable doubt. However, it does not provide an absolute degree of certainty, as empirical evidence (such as the map of cosmic microwave background radiation collected by telescopes) plays an important role in proving the Big Bang theory[2]. This type of evidence is inductive (created using large quantities of data collected by astronomers) and can, therefore, provide only an inductive conclusion. This type of

[1] Overbye, Dennis, "Cosmos Controversy: The Universe Is Expanding, but How Fast?", New York Times, 2017
[2] European Space Agency, "Cosmic Microwave Background (CMB) radiation", https://www.esa.int/Science_Exploration/Space_Science/Herschel/Cosmic_Microwave_Background_CMB_radiation

conclusion does not provide us with the absolute degree of certainty; furthermore, it illustrates how even in exact natural sciences absolute certainty is unattainable.

Object 2: Mathematical Axioms



The second object of my exhibition is a set of mathematical axioms. I chose this object because I study mathematics at a higher level and found this object to be important when addressing the certainty of the application of mathematical knowledge. Mathematical knowledge is created by using deductive reasoning to prove statements from the axioms; mathematical operations and relations (such as addition, multiplication, and equality) are based on logical connections between statements, thus making the mathematical proof deductive and giving it an absolute certainty. Even the proof by mathematical induction is not inductive (as the word is defined in ToK context) but deductive. This means that assuming the premises of a mathematical argument (the axioms) to be true, the mathematical argument will be of absolute certainty.

It is, unfortunately, impossible to prove the validity of the axioms. Historically, they were based on human intuition while observing the natural world. However, in the last centuries, it became apparent, that intuitive axioms do not always reflect reality. An example of an intuitive axiom failing to represent reality is the parallel postulate. A mathematical system where this axiom is not upheld is called non-Euclidean geometry[3]. The usefulness of this area of mathematics is not limited to pure mathematics; it also has real-world applications, for example in Einstein's theory of relativity[4]. Nevertheless, for a long period of time this, now universally accepted branch of geometry, was considered nonsense[5]. This example shows that even mathematics is susceptible to

[3] Britannica, The Editors of Encyclopaedia, "parallel postulate", Encyclopedia Britannica, 2010
[4] Britannica, The Editors of Encyclopaedia, "non-Euclidean geometry summary", Encyclopedia Britannica, 2003
[5] Lewis, Florence P., "History of the Parallel Postulate", The American Mathematical Monthly, vol. 27, no. 1, 1920, page 19

paradigm shifts and that earlier-held unquestionable beliefs are not always correct. This also means that mathematical statements (and how they reflect reality) can, to a limited extent, be subject to interpretation. For example, the statement that the sum of the angles of a triangle is always 180 degrees holds only in Euclidean geometry (where the parallel postulate applies), but not in non-Euclidean geometry (like on a curved surface). Therefore, the dilemma of choosing necessary mathematical axioms casts doubt about the certainty of the application of mathematical knowledge.

Object 3: German-Lithuanian languages dictionary, dr. R. Ekertas, dr. E. Bukevičiūtė, dr. E. Hemmerling (1989)

The third object of my exhibition is a bilingual German-Lithuanian dictionary. Since I study three languages in the IB programme (English, German, and Lithuanian), I thought it would be suitable to explore the degree of certainty attainable in language translation, particularly using a bilingual dictionary.

The names we provide to various objects are knowledge of absolute certainty. This is because we have the ultimate control over this area of knowledge. This also tends to hold up when translating between different languages. Nevertheless, perfect translation even of a single word is not always possible. One of the reasons is polysemy, which is the coexistence of many possible meanings for a word or phrase[6]. For example, in German, the word *die Bank* can mean both *the bank* and *the bench*, whereas in Lithuanian (like in English), different words (*bankas* or *suolas*) are used. This can lead to a loss of certainty when translating a German sentence like "*sie stehen neben der Bank*" (meaning: *"they are standing near the bank/bench"*) from German without further context, as the translator is forced to choose whether *Bank* means *suolas* (bench) or *bankas* (bank). There are more reasons why translating even a single word can reduce certainty. A word existing in one language might not exist in another due to cultural, historical, geographical,

[6] Merriam-Webster.com Dictionary, "Polysemous", Merriam-Webster

social, etc., reasons. For example, a traditional Lithuanian meal *Cepelinai* is a rare dish to encounter in German-speaking countries, therefore, a direct single-word translation does not exist, and a longer explanation is required. This explanation might reduce the artistic effect if the word is used as a poetic device or might be too precise or too imprecise, thus reducing the certainty of the translation. The examples illustrate how even single-word translations might struggle to achieve absolute certainty.

Word count: 922

Sources for images:

Source for image 1: Space.com

Source for image 2: wikipedia.org (no author provided)

Source for image 3: my own photo

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