ESSAY 1 " Humans are pattern seeking animals and we are adept at finding patterns whether they exist or not" (adapted from Michael Shermer). Discuss knowledge questions raised by this idea in two areas of knowledge.

To seek patterns is to find threads that weave together events, ideas and facts, using evidence to form interpretations. The notion that "humans are pattern seeking animals"[1], as the quote suggests, is a far reaching one, especially in regards to the production and acquisition of knowledge. As a Physics student, I learn theories that aim to explain the phenomena of the natural world. Similarly, as a Philosophy student, I focus on theories that aim to explain human thoughts and ideas. In my experience, both in Natural and Human Sciences, there is an emphasis placed on a learner's ability in pattern seeking. From information presented, learners have to use their faculties to fully understand the basis of theories, and to be able to apply these theories to other, more varied, scenarios. In the Natural Sciences, pattern recognition, through experimentation and theory has a huge role to play in the production of knowledge. Using existing data, patterns must be observed, and sometimes created, for theories to come into existence. In the Human Sciences, there is a parallel; through less reliant on empiricism, Human Sciences aim to map patterns of human thought and behaviour in methods similar to those of the Natural Sciences. As such, this paper aims to examine the human tendency to seek and create patterns, particularly in the areas of knowledge of the Human Sciences and the Natural Sciences. By extension, the way by which we evaluate these interpretations we form through pattern seeking.

Pattern seeking and creation is a human endeavour. It is something crucial to our knowledge systems.[2] Not only do we use what is available to us to decipher patterns, but also, we use patterns to gain more knowledge from existing information. Observing gravity on earth began as deciphering a pattern from observations on our planet. However, through use of reason and imagination, theories grew to include the rest of the universe, even areas that we cannot physically observe. Now, we apply the laws of gravity to areas of space we cannot observe. Much of our theoretical knowledge is similarly extrapolated, based upon patterns we observe and fabricate. Our models and assumptions spring from our ability in pattern creation, in addition to pattern seeking.

During practical physics classes, the aim is for a student to conduct an experiment of their own, and find the theoretical explanation for their results, that corresponds with existing equations and formulae. Sense perception is crucial to empiricism, and gives us the data points for further study. Imagination is a similarly important element, necessary to conceptualise the line that connects these elements. The process to reach the correct outcome involves graphing, comparing, and finding trends in data. When I conducted my experiment, based upon the physics of light, I reached a standstill in my experiment. I thought that there was no logical connection between the points. I managed, however, to use my imagination to find that my results corresponded with obscure equations, the Fresnel[3] equations, that had not been taught as part of the physics syllabus. Finally, it was through use of reason that I found a logical connection in this experiment. This process displayed elements of pattern seeking, of gathering the facts I had, and forming a coherent line of argument from my available data. The fact that this process played such a huge part in the learning journey that defines scientific study implies the importance of pattern seeking in both the acquisition and production of knowledge in this field. In the Natural Sciences, every discovery of a relationship between data points must be substantiated by a model, usually denoted by a line on a graph, or an equation, thus creating a rule for use in deductive reasoning. To have formed the equations upon which we base our experiments, scientists of the past underwent a similar process of tying strings together and finding patterns. To learn these concepts now, students are challenged to find these patterns for themselves, to go through the process and, through this, enrich their understanding. They are also challenged to create hypotheses – thereby creating patterns before having observed the results of the experiment. This goes back to the philosophy of science, and the fundamental question of why science exists. Essentially, patterns are the means through which we see logical threads in an otherwise incomprehensible universe; the natural world would remain a mystery without the scientific method. Our personal and shared knowledge is enriched by the cooperation of sense perception, reason and imagination in our search for and creation of pattern. The Natural Sciences depict our proclivity toward finding patterns that explain physical phenomena.

The Human Sciences, as a whole, show this same desire to map general patterns and rules, and thus explain human behaviour. Take the study of Economics, for instance. Using the given evidence, a logical, "systematic"\ interpretation is formed, often in graphs, models and equations. This can be seen even in one of the most simple economic theories, that of price and demand. The line that defines the relationship between price and demand is a manifestation of a pattern of human behaviour, reproduced and simplified. This is an example of a general rule created through the use of reason, alongside imagination, in pattern seeking.

Yet, can our pattern seeking go too far? Our search for pattern and correlation is not necessarily a perfect model; in searching for relationships, we often find ourselves too quick to connect the dots, resulting in the discovery of patterns that may not truly signify anything. A simple search for "unusual correlations" would uncover troves of ridiculous and meaningless correlations, patterns that have no use or implication. For instance, it has been found that "United States' Spending on Space-Technology" has a positive correlation with "suicide by asphyxiation"[4]. We do not see the United States cutting their Space budget due to this particular piece of information, presumably because there is no logic behind this particular correlation. The existence of useless patterns paves the way to the conception of conspiracy theories, as well as arguments that might be harmful. Misread patterns could, by extension, come through as racism, xenophobia, and other forms of prejudice. This gives rise to the question: how might one tell between a useful interpretation of evidence, and one that exists as mere coincidence, or as a result of other factors? For instance, if someone took the SAT score gap[5] between races at face value as a "pattern", neglecting to do research regarding factors that cause the gap, they might form baseless beliefs in the intellectual superiority of some races over others, when the true reasons might not be quite so divisive. In politics, many take advantage of these sorts of correlations and patterns, especially in the interest of marginalising a group. A misjudged creation of patterns, notably the assumption that correlation is the same as causation, can lead to fallacious reasoning. The counter claim can thus be made that, as shown examples like "useless correlations", patterns might not be so useful to us after all.

But, this is where logic becomes important. It can be argued that if reason is properly used in deciphering and applying patterns, not only in the creation of correlations but also in the evaluation of the value of found patterns, useless correlations and meaningless patterns could be dismissed, and useful ones prioritised. Thus, for useful patterns that contribute to the production and acquisition of knowledge, non-fallacious reasoning must regulate our pattern seeking and creation.

In the study of philosophy, we try to identify patterns to answer ethical and moral questions. When discussing the topic of Animal Rights, there came polarising views on either end of the spectrum due to diversity of interpretation, and the presence of bias in interpretation. Yet, upon listening to the opinions of the other side, and using reason to evaluate both viewpoints, we managed to come to a consensus that took two different interpretations of evidence into consideration. This exemplifies the way in which reason and imagination can come together in shaping both personal and shared knowledge. A personal interpretation of evidence, a pattern one sees, must be questioned and looked upon using reason. Only then can it be evaluated, for us to be able to decide whether the pattern is useful or not, for the creation of a more general rule or consensus.

Pattern-seeking, defined as the use of evidence in crafting interpretations, is something that defines humanity. In areas such as Natural and Human Sciences, we see a core similarity: the search for logical threads to explain phenomena. In both these areas of knowledge, our ways of knowing work hand in hand to create links between pieces of evidence, and this is instrumental in the processes of knowledge production and acquisition. Reason has the additional task of regulating connections, and ensuring that there are distinctions between useful correlations that add to personal and shared knowledge, and patterns that make no logical sense. Patterns are necessary for the expansion of knowledge, but not necessarily always useful. Thus, pattern seeking and creation, when carried out through logical framework, forms the basis for production and acquisition of knowledge in the Human Sciences and the Natural Sciences. The implication that arises from this is the importance of awareness in pattern-seeking and pattern creation; learners must be able to use reason to make distinctions between patterns they encounter. We seek patterns, and we craft interpretations in response to evidence and data, but we must sift through these, to choose the patterns valuable enough to be kept as knowledge.

(1587 words)

Works Cited:

"15 insane things that correlate with each other." n.d. Web. 5 Dec. 2016.

<http://www.tylervigen.com/spurious-correlations>.

Law, Snell's. *PowerPoint Presentation*. 2011. Web. 5 Dec. 2016.
<https://www.tcd.ie/Physics/people/Charles.Patterson/teaching/PY4P05/Fresnel_Equations.pdf>.

Regents, UC. *THE GROWING CORRELATION BETWEEN RACE AND SAT SCORES: New findings from California by Saul Geiser*. 15 Oct. 2001. Web. 5 Dec. 2016.
<http://www.cshe.berkeley.edu/publications/growing-correlation-between-race-and-sat-scores-new-findings-california-saul-geiser>.

Shermer, Michael. *Michael Shermer*. 1992. Web. 5 Dec. 2016.
<http://www.michaelshermer.com/2000/02/chicken-soup-for-the-evolutions-soul/>.

ESSAY 2 : "The production of knowledge seems to require creativity at every stage of the process." Discuss this statement with reference to two areas of knowledge.

"I'm waiting for inspiration...You can't just turn creativity on like a faucet."
–Calvin, Calvin and Hobbes

One must ponder: if Calvin, an over-imaginative young (fictional) boy, finds a dearth of creativity in his pursuits, then can it really be so abundant in reality as the title suggests? The central issue I find with the title is that there is a vast dichotomy between relatively abundant knowledge production (KP), (through scientific experimentation, artistic innovation, sociological research, and countless other processes) and the obscurity of the genius inspiration we bind creativity to. Even when creativity is present, is it true that knowledge production processes (KPPs) necessarily require it constantly at every point, seeing as a creative process does not necessarily imply it has high barriers to produce knowledge?

With the above queries, seeing creativity as inspiration, originality, and innovation, I look to the Natural Sciences and the Arts. From the glorious mind of Oppenheimer to legends such as Van Gogh, these two fields scream creativity, and thus fairly test the overarching question. KP is the formation of new information, creations, or works in any field, from scientific data to a new piece of music. Stages of KP are distinguishable sections; in the Sciences: hypothesis, experimentation, and conclusion; in the Arts: conception and creation. By analysing the nature of these AoKs, I will explore both sides of the title.

The Natural Sciences are an investigation of the unknown. Curiosity and enquiry push scientists to create highly imaginative, and thus creative, hypotheses at the first stage of KP. Does this human curiosity necessitate creativity in the following stages? One may argue yes. For example, the initial conception of nuclear fusion- the idea that stars gain their energy "from the fusion of hydrogen into helium" - by Eddington was an unparalleled concept that sparked from his own reason and imagination. It was creative. In order to experiment this knowledge in the next stage, physical boundaries had to be pushed. New physical technologies had to be created. Creativity in engineering and experimentation had to follow to create machines such as the "stellarator" and then the "tokamak" . Creativity in technical advancements- fine-tuning technologies such as "magnetic configurations" in the machines - had to be applied. Such examples of continual creativity are common in the Natural Sciences, where ideas are so bold that constraints on existing physical limits must be broken through sheer imagination and innovation. Thus, KP in processes with an immensely creative first stage must be creative in every subsequent stage to overcome the obstacles to new knowledge.

However, we should ground this discussion in reality, where often, scientific problems are not bound by the physical constraints of methods or technology. Instead, existing processes and knowledge are applied to create new scientific knowledge; this is the scientific method . In this vein, we should ask: Does the nature of the scientific method mean certain steps are inevitably uncreative? To illustrate this, during the 1854 Broad Street cholera outbreak , John Snow had the innovative idea that disease was being spread through contaminated water supplies, while being rejected by the scientific community . Despite initial creativity, Snow's next stage, data collection did not particularly require creativity, and was utterly orthodox. He simply asked individuals about their contact with the water supply and charted this information down in a systematic manner . This was a rote procedure and required no creativity. Yet, through this, Snow was able to validate his claim and create knowledge. So, even if initial stages are creative, the KPP may not necessarily require further creativity to produce scientific knowledge, due to the nature of existing, systematic experimentation.

One may even contest the assumption that scientific KP always requires creativity in its first stage. If science is an exploration of the unknown, then is it not possible that one produces knowledge without having an original vision or hypothesis? One may thus claim that KP in the Natural Sciences is entirely dependent on outcomes. These, lacking a vision or purpose, are uncreative. Let us consider the phenomenon of serendipity. Scientists discovered the "first lithium-rich giant star... [that is] close to the red giant branch bump in a globular cluster" through observation of "FLAMES spectra" - an existing method of analysis. The scientists claimed the star was "serendipitously identified" as knowledge produced was entirely a result of chance in data collection. There was no creativity involved in hypothesising the specific outcome, nor in interpreting the data, as the conclusion was objectively confirmed as soon as the data was obtained. Thus, we may also consider that, since science may stumble upon new knowledge which has not even been theorised, and can find it essentially as a by-product of ongoing processes, KP does not have to be creative at every single stage.

Where creativity in scientific KP seems circumstantial, artistic KP is usually characterised as always creative. This intuitive assumption must be tested. Because artistic knowledge (AK) is an abstract concept, I will personally interpret it as the product of an artist's emotional, reason-based, or imaginative intent to create art made manifest into something to be experienced via sense perception. If the intent was anything but to create art (eg. recreating or copying works, vandalism etc.) this is not KP, and is not relevant to this essay.

An intuitive assessment suggests that artistic pursuits inherently require creativity at all stages as an artist must have a unique, intangible, intentional vision to create AK. This unique conception means that the physical creation must be creative by virtue of the entire project's uniqueness. An example of this is in abstraction, where artists create works that do "not attempt to represent an accurate depiction of a visual reality" . Despite each work being a seemingly arbitrary mash of shapes and colours, artistic creativity resides in the nuances. Each artist has a unique emotional or imaginative spark when creating their work, as no two individuals can have the exact same thought process. They conceive and create based on their unique experiences, transferring this to the canvas. This human intangibility and emotional complexity means these works could only be created by the unique thought of their creators- they are creative in their uniqueness.

Still, it is clear that the above argument is idealistic. If an artist uses the same techniques as another, their overall conception may be creative. However, by utilising an existing technique, the stage of creation is unoriginal and thus does not require creativity. It is derivative. Since Jackson Pollock's pioneering of the "drip painting" technique, other artists following suit have created unique AK, but without the creativity needed to innovate an original method. In order to fully express himself, Pollock had to invent an entirely new technique. Conversely, his successors merely imitated his creativity. Creative vision and emotion do not qualify a derivative process as creative; there is a distinction between creating new knowledge with new methods, and creating new knowledge with old methods.

An interesting perspective in the Arts is that of the interpreter of art; the artist may not control the entire KPP. Instead, the KPP extends to the interpretation of and interaction with artwork by other knowers, of different backgrounds and beliefs. After all, one purpose of art is to convey knowledge . Personal knowledge is thus created when the impact of art on a knower produces new knowledge in that knower, emotional or otherwise. This depends on their personal experiences. Thus, we must investigate whether producing personal knowledge is creative. On one hand, it may not be, as pure intuition is sometimes used to form personal knowledge. I saw an illustration of this at the Human+ exhibition in Singapore ; the "Improvised Empathetic Device" is an artistic contraption, worn on the arm, that causes physical pain to the wearer upon a soldier's death in Iraq in real-time. Wearers created knowledge of the actual physical deaths of individuals exclusively through sense perception. Similarly, with other art, audiences' interpretations are also often intuitive and uncreative. So, personal knowledge can be created without the originality or intentionality needed to be creative.

However, we should not conflate the above intuitive interpretation of art with the inspiration common in art to create new works. Not everyone who interprets art is a layperson. Other artists with their own visions draw upon the influence of other artists to form new artistic knowledge. For example, Christopher Nolan's reimagining of Batman to create the Dark

Knight Trilogy was an extension of the creative legacy of Bob Kane . Nolan had to apply his own ability to imagine and reason how to portray this on screen in a unique fashion . In fact, this example counters the notion that personal knowledge is always intuitive. Such critical inspiration instead requires logical analysis to internally consolidate the effect of an artwork on the knower and incorporate this into new work. Thus, this application of personal knowledge requires creativity.

Overall, our analysis puts enough doubt upon the title to negate it. KPPs, as seen, are so diverse and occur at so many different levels of complexity that creativity is not always required to overcome the barriers to new knowledge. Intuition and blind luck can just as easily create new knowledge as reason and imagination. KP is not limited to genius and, thus, creativity is not necessarily required at every stage. This said, it remains true that when an idea is utterly ground-breaking, its following stages are, more-often-than-not, creative. However, it must be noted that these cases are far fewer in number than the majority of KPPs that operate on existing processes.

(1592 words)

Bibliography/Works Cited

Arnaux, Robert. "Who Invented Fusion?" ITER. N.p., n.d. Web. <www.iter.org/newsline/-/1836.>.

"Bob Kane." Batman Wiki. N.p., n.d. Web. <http://batman.wikia.com/wiki/Bob_Kane>.

"CartridgeSave." The Amazing Creations of 12 Incredible Splattered Paint & Ink Artists. N.p., n.d. Web.

D'Orazi, Valentina, Raffaele G. Gratton, George C. Angelou, Angela Bragaglia, Eugenio Carretta, John C. Lattanzio, Sara Lucatello, Yazan Momany, and Antonio Sollima. "On the Serendipitous Discovery of a Li-rich Giant in the Globular Cluster NGC 362." On the Serendipitous Discovery of a Li-rich Giant in the Globular Cluster NGC 362. N.p., 04 Feb. 2015. Web. <https://arxiv.org/abs/1502.01341>.

Hughes, Mark. "Exclusive: Christopher Nolan Talks 'Batman Begins' 10th Anniversary."Forbes. Forbes Magazine, 30 July 2015. Web. <https://www.forbes.com/sites/markhughes/2015/07/30/exclusive-christopher-nolan-talks-batman-begins-10th-anniversary/#30dec8b4a8b5>.

"HUMAN + THE FUTURE OF OUR SPECIES." HUMAN + The Future of Our Species. N.p., n.d. Web. <http://www.marinabaysands.com/museum/human-plus.html>.

"I.E.D." SWAMP. N.p., n.d. Web. 20 Aug. 2017. <http://www.swamp.nu/projects/ied/>.

"Jackson Pollock." Encyclopædia Britannica. Encyclopædia Britannica, Inc., n.d. Web. <https://www.britannica.com/biography/Jackson-Pollock#ref149179>.

"John Snow and the Broad Street Pump." UCLA: Department of Epidemiology. N.p., n.d. Web. <www.ph.ucla.edu/epi/snow/snowcricketarticle.html>.

Tate. "Abstract Art – Art Term." Tate. N.p., n.d. Web. <http://www.tate.org.uk/art/art-terms/a/abstract-art>.

"The Purpose of Art." Changingminds.org. N.p., 10 Mar. 2013. Web. <http://changingminds.org/blog/1303blog/130310blog.htm>.

"The Scientific Method." Khan Academy. N.p., n.d. Web.

<https://www.khanacademy.org/science/biology/intro-to-biology/science-of-biology/a/the-science-of-biology>.

Tino, Palo. "The Dark Knight Trilogy." IMDb. IMDb.com, n.d. Web. <http://www.imdb.com/list/ls009599512/>.

Watterson, Bill. "Calvin and Hobbes by Bill Watterson for May 24, 2012." GoComics. N.p., 24 May 2012. Web. <http://www.gocomics.com/calvinandhobbes/2012/05/24>.

Xu, Yuhong. "A General Comparison Between Tokamak and Stellarator Plasmas." Matter and Radiation at Extremes 1.4 (2016): 192-200. Web. <http://www.sciencedirect.com/science/article/pii/S2468080X16300322>.

ESSAY 3 "Over time, knowledge has become more accurate." Discuss this statement with reference to two areas of knowledge.

David Hume has once said: "All knowledge degenerates into probability"[1]. He believed that all knowledge, sooner or later, will eventually become a mere guess of probability instead of a certain truth or fact. The quote suggests the idea that going along with the acquisition of knowledge is the question of its accuracy. It seems obvious that over time, we accumulate more experiences in our methods and gain more accurate knowledge. However, can our methods always progress or are they misleading us? In this essay, I will contend that knowledge in Natural Science as well as Human Science cannot always become more accurate. In Natural Science, the accuracy of knowledge is challenged by scientists' misuse of technology as well as the ethical concerns in the scientific method while in Human Science, models that researchers use seem to be evolved or even dismissed over time.

First of all, it is undeniable that knowledge in both Natural Science and Human Science has become more accurate over time.

The development of technology has supported scientific method in collecting more concrete evidence so as to reinforce the accuracy of knowledge in Natural Science.The scientific method is a means to obtain knowledge by scientists. First, scientists make observation to draw a hypothesis. Using experiments and reasoning, they will be able to prove or disprove the hypothesis. Repetition of the method can also improve the accuracy of the knowledge. Technology is a useful tool in experiments and reasoning. As new technology is developed, experiments will provide more accurate data. For example, physicists have been trying to prove the accuracy of the Standard Model of Physic. The model states that: "Everything in the universe is found to be made from a few basic building blocks called fundamental particles, governed by four fundamental forces"[2]. Even though the model has been hypothesized for years, its accuracy has yet to be proved. With a newly developed technology called the Large Hadron Collider (LHC), scientists were able to carry out many experiments in 2012 to discover the existence of the Higgs boson, a fundamental particle which is responsible for the mass of substances[3]. This discovery has helped to solidify the Standard Model of Physics. The use of the LHC has improved the scientific method that was used to prove the Higgs boson's existence. This new discovery has thus increased the accuracy of the

Standard Model.Therefore, over time, scientific knowledge can indeed become more accurate with the aid of new technology.

Knowledge in Human Science depends more on human behaviors which researchers usually base on to raise a hypothesis. Accumulative experiences and data collected over time will provide more concrete evidence to prove or disprove the hypothesis, and hence knowledge has become more accurate. This can be shown by the development in many fields of psychological science such as human memory area. Twenty five years ago, Elizabeth F. Loftus proposed the research on memory distortion as a foundation for the famous False Memory Research. Loftus first studied on how people might have their memories contaminated due to their surroundings and others' suggestions. Her thesis was then disputed by a lot of people among her field, because the idea of distorted memories challenged the therapists' successful method of uncovering repressed memories at that time. After Loftus's research came the Deese-Roediger-McDermott's study. The experiments showed that subjects' memory of a word could be altered if they read other words that are related to the first given word. The results from these experiments have helped to solidify the accuracy of Loftus's research with more concrete evidence. Furthermore, it has also initiated the development of a new theory called "imagination inflation"[4]. This means accumulative evidence will also result in the establishment of new knowledge. In other words, more evidence found will prove the accuracy of knowledge, at the same time raise a new hypothesis. From this example, it can be concluded that the process of generating more evidence and establishing new knowledge is an everlasting process. Thanks to the cross analysis, in addition to the frequent peer view and the increasing quantity of replicated experiments, the accuracy of knowledge in Human Science has been improved continuously, creating more accurate knowledge over time.

Hence, it can be concluded that over time, innovative technology and accumulative experiences have improved the process of obtaining more accurate knowledge in Natural Science and Human Science accordingly.

Nevertheless, knowledge has not always acquired more accuracy over time.

In Natural Science, even though technology might enhance the reliability of scientific method, the method itself still has errors due to possible mistakes in the analysis process as well as in scientists' mastery of technology. Take an example of numerous mistakes in DNA profiling that have occurred due to human errors. In 1999, Josiah Sutton was sentenced to 25 years in prison because his DNA was found to match the DNA of a sexual assaulter. When the DNA reports were sent to experts, they all agreed to retest the DNA samples because the report was too unprofessional as an evidence for Josiah's case. After retesting, it was found that the DNA sample of Josiah and that of the assaulter did not match each other. The first report was false because technicians in the laboratory had contaminated the samples by accident before testing[5]. The study has shown that although DNA profiling can convict people of crime, it can also be used to prove they are innocent. This problem has clearly proved that despite the aid of advanced technology, scientific methods are still flawed because of scientists' misuse of the instruments and how they interpret the data given. The unreliable analysis process will result in inaccurate evaluations. For such reason, scientific method cannot always solidify the accuracy of knowledge, regardless whether it is enhanced by better technology or not.

In Human Science, most knowledge is based on academic theories such as mathematical models. Although these models can illustrate a part of reality, they can never illustrate it as a whole because reality is too complex for any model to faithfully represent it. Therefore, knowledge cannot always become more accurate over time due to researchers' dependence on models and theories. This problem could be observed in the 2008 Financial Crisis. In USA, there is an enormous chain of lenders, borrowers, banks and investors which is dependent on mortgages from borrowers with very high default risk. As people became greedier from the rising earnings, they increased the number of risky mortgages. When the price of houses suddenly decreased, hundreds of borrowers were in default, all the risky mortgages lost their values, leading to the Financial Crisis[6]. One of the models, the neoclassical model which many economists used to predict the economy before the crisis, presumes that the house market system is stable and faithful[7]. Such presumption creates many uncertainties in the model. Most mathematical equations are based on the fact that every human behavior in the market is rational while in reality, individual thoughts and actions can be spontaneous and unpredictable. For that reason, most economists who used neoclassical model could not predict the unexpected greed from the banks and borrowers, and thus could not predict the Financial Crisis. This means that predictions, which are a kind of knowledge, made based on models in Human Science cannot always be accurate.

Therefore, knowledge cannot be proved to become more accurate over time due to misuse of instruments in Natural Science and the incapability of models in Human Science to faithfully represent the reality.

In a different perspective, sometimes the accuracy of knowledge cannot be determined due to limitations in obtaining knowledge. Though some knowledge might be accurate, it is not possible to prove so.

Morality and ethical concerns are factors which prevent the establishment of accurate knowledge in Natural Science. Social and cultural norms have an important role in acknowledging the morality of a research. If a research is considered as unethical by the majority of society, scientists will not be able to carry on the research. This discontinuation will prevent scientists from gaining more accurate knowledge. For example, there has been ethical controversies over human cloning. In 2005, the UN committee agreed to ban all forms of human cloning because they were considered incompatible to human dignity and human life.[8]However, many countries disputed the prohibition by claiming that if they could get access to human cloning, it would give them more opportunities to gain useful knowledge not only in the genetic engineering field but also in other fields, because human clones could be used for experiments in many scientific fields. From this example, it can be seen that all knowledge in Natural Science is connected to one another. Once scientists cannot have access to a knowledge due to ethical concerns, they will lose access to many other knowledge. Therefore, sometimes it is difficult to enhance the accuracy of knowledge in Natural Science for the enhancement can bring harm to society in general and hence it is restricted.

To recapitulate, it seems like knowledge in Natural Science and Human Science are aided with more reliable sources and methods to become more accurate over time. However, with a closer look, these sources and methods still carry many uncertainties that do not ensure the accuracy of knowledge. The process of producing and obtaining knowledge, after all, still involves the role of humans, and humans cannot be absolutely flawless. At some point of the process, there will be falsehood such as subjectivity, fallacies or limitations. The idea that knowledge has always become more accurate over time is thus only agreeable to a certain extent.

(1600 words)

ESSAY 4

"Every theory destabilizes as much as it solidifies our view of the world" (Nathan Jurgenson). Discuss. [1525 words]

Human knowledge is an ever-changing bank of proven theories and speculation. Looking at the idea that "Every theory destabilizes as much as it solidifies our view of the world" (Nathan Jurgenson), we can determine that whilst our knowledge base is assessed and curated over millennia by many of the world's top experts using logical Ways of Knowing (WOK) like sense perception, reason and intuition among others, that knowledge is never concrete in its truth. Therefore, paradigm shifts, re-assessments and significant alterations to given knowledge exist within many Areas of Knowing (AOK) and we will focus on History and Natural Sciences as case studies. In History, destabilization occurs when over time declassified documents and new information is given to the public, giving rise to changing perspectives. Destabilization can also occur due to the changing moral principles of society, such as how gradually American society has become less tolerant of statues commemorating Confederate heroes[1]. For the Natural Sciences, destabilization occurs when emergence of new theoriesredefines our definition of the certainty of truth. Solidification of ideas for both AOKs is the point at which a significant portion of society accepts a new way of thinking.

In History, destabilization of widely-believed common knowledge can happen when declassified documents and new accounts are released, often altering our perceived picture of how, when and why certain parts of history transpired. This leads to new theories on why certain actors behaved in the way they did, which henceforth leads to the solidification of knowledge as a critical mass of people eventually embrace this new idea. To quote Winston Churchill, “History is written by the victors”[2], with many secret classified activities transpiring throughout history, the discovery of which changes major concepts and conflicts within our understanding of history and hence, our view of the world. History constitutes a fragmented part of a whole, for no historian can fathom every single small historical event that has ever occurred. Henceforth, with this limited amount of knowledge, we connect the dots from event to event to rationalise how and why history has transpired. However, the inclusion of new knowledge can completely change this ‘map’ of historical understanding we have already produced, destabilizing our perception of the world. A good example is the Cuban Missile Crisis. For decades, historians like Arthur M. Schlesinger Jr[3]. and attendants of the Kennedy administration like Ted Sorensen [4]assumed that Khrushchev's reason for placing the missiles in Cubawas because he feared American U2 spy planes had exposed the fact that the Soviet Union lacked the missile firepower America feared so much[5]. He therefore placed missiles in Cuba to send the US the message that Russia was still armed and dangerous and increase his political prestige. However, following the release of more declassified documents, it’s clear this was not Khrushchev’s intention. The placement of missiles in Cuba was meant to protect Castro and incite revolution in Latin America[6]. Yet, because America misinterpreted Khrushchev's intentions, the Cuban Missile Crisis ended becoming the closest the two states would come to nuclear war. The tension created during this period is why the traditionalist idea of Khrushchev placing missiles in Cuba for political prestige still exists despite the evidence. Over time, modern historians have come to accept this new perception due to the amount of evidence from declassified reports and the affirmation of the view by Khrushchev's aides and Fidel Castro. Thus, we can say that whilst this new theory has destabilized the traditional historical perception of the Cuban Missile Crisis, it has also solidified our knowledge of Khrushchev's motivations.

Yet, certain events are substantiated with such overwhelming evidence that refuting them often necessitates major paradigm shifts which require substantial amounts of counter-evidence and thus given that such counter-evidence would be hard to produce to a convincing extent, these shifts are unlikely to happen. To explain this, we can look at the phenomenon of Holocaust denial. This curious phenomenon has existed since the early 1960s [7]and has been propagated by several influential people like Fred Leuchter[8]and David Duke[9]. Yet the movement and the theories it has proposed have never been given serious thought because of the huge amount of physical evidence provided, such as documentary evidence and personal anecdotes from veterans. There is a possibility that the holocaust was a hallucination and not actually suffered by the Jewish population of Nazi-Germany. However, this is very unlikely considering the physical evidence from both survivors[10]and Allied documentaries[11]of the camps they found that exists and the fact that 6 million Jews went missing[12]. This is why not many dispute that the Holocaust happened. This means that the knowledge of the Holocaust having happened is generally solidified in our view of the world and is very difficult to destabilize. Theories that are brought up by Historians about the Holocaust may dispute the exact specifics and statistics of the Holocaust, but do not dispute that it happened, and therefore solidifies our view of the world.

Can scientific knowledge challenge worldviews in the process of unifying them? The Natural Sciences is the study of the natural world through systematic, methodological frameworks. It comes as no surprise then that Paradigm shifts occur. As our equipment for measuring and analysing the science of nature improves, we often discover new knowledge that can completely re-define our original understanding of the subject at hand. An example is the centuries-long debate on the existence of luminiferous aether[13]. In his dialogue Timaeus, Plato states that "there is the most translucent kind which is called by the name of aether (αίθηρ)"[14], speculating that planetary bodies of the solar system were immersed in a transparent fluid called aether that allowed light to pass by. The popularity of this theory and its acceptance as a fact for more than a millennium was due to the explanation it provided for the permeation of light and the concept of gravity. Even Isaac Newton's particle theory of light accepts that there is a form of aether surrounding the planetary bodies[15]. It was not until the Michelson-Morley experiment of 1887 that the concept of aether was disproved[16], and Einstein's formulation of Special Relativity in 1905 and his subsequent solidified theory of relativity in 1910 managed to explain all the experimental results of the past millennium without the need for an aether[17]. Whilst the Michelson-Morley experiment of 1887 was temporarily known as the "most famous failed experiment in history"[18]for failing to provide any insight into the properties of aether, repeating the experiment multiple times confirmed there was no such thing as aether, destabilizing the entire scientific community. However, it is because of this destabilization that additional experiments took place, helping us solidify our understanding of the universe. The destabilization of previously assumed axiomatic premises allowed scientists to consider theories and thus conduct experiments that did not base themselves upon the automatic adoption of such premises as fact.

Yet, recognise that much of our understanding today in the natural sciences are based on constant improvements to theories that cannot be disproved without a major paradigm shift. In the Standard Model of physics[19], we make certain assumptions about how subatomic particles behave and then based on these assumptions, we form new theories. If these theories appear to be accurate in describing how our world works, then it solidifies our original assumptions that these theories were based on. Based on the assumptions present in the standard model, the existence of the Higgs boson was consequently proposed in the early 1960s[20]. Described as the "ultimate verification[21]," of the Standard Model, the Higgs boson was theorized but never truly proven because direct production and verification would take massive computing power which technology has been unable to create until now. The proving of the Higgs boson in March 2013[22] using results from the Large Hadron Collider suggests that this theory is accurate and therefore solidifies our view of the world. Consequently, unless there is a massive paradigm shift, it becomes increasingly unlikely that the Standard Model, and by extension our understanding of how the world works at a subatomic level, can be destabilized. Hence, today any theory proposed that runs counter to the principles of the Standard Model of physics is immediately questionable in its legitimacy because the principles of the Standard Model are so solidified.

To conclude, the idea that every theory destabilizes as much as it solidifies our view of the world can be proven from the various shifts that occurred in the AOKs of History and Natural Sciences. In many cases whilst the community was destabilized temporarily and rejected some of these new theories, they eventually were incorporated into our perception of knowledge and helped to solidify our view of many things. Yet, we cannot go so far to claim that often the discovery of one new fragment would utterly destabilize the whole design, as there are many facts and constants also set in stone to our current knowledge. However, the human species is always driven by a quest for curiosity and new knowledge so destabilization and solidification of theories are a normal cycle towards the construction of knowledge.

<u>Bibliography:</u>

“Combating Holocaust Denial: Evidence of the Holocaust presented at Nuremberg.” United States Holocaust Memorial Museum, United States Holocaust Memorial Museum, www.ushmm.org/wlc/en/article.php?ModuleId=10007271. Accessed 24 May 2017.

[1]Eisenhower, Dwight D., and Joseph Patrick. Hobbs. Dear general: Eisenhowers wartime letters to Marshall. Baltimore, Hopkins Pr., 1971.

“Documenting Numbers of Victims of the Holocaust and Nazi Persecution.” United States Holocaust Memorial Museum, United States Holocaust Memorial Museum, www.ushmm.org/wlc/en/article.php?ModuleId=10008193. Accessed 24 May 2017.

“KKK's David Duke Tells Iran Holocaust Conference That Gas Chambers Not Used to Kill Jews.” Fox News, FOX News Network, 13 Dec. 2006, www.foxnews.com/story/2006/12/13/kkk-david-duke-tells-iran-holocaust-conference-that-gas-chambers-not-used-to.html. Accessed 24 May 2017.

"Winston Churchill Quotes." *BrainyQuote*. Xplore, n.d. Web. 12 June 2017.

Blum, Edward K.; Lototsky, Sergey V. (2006). Mathematics of physics and engineering. World Scientific. p. 98.

Brewer, Ebenezer Cobham. A guide to the scientific knowledge of things familiar: with an appendix of questions without answers. London, Arnold & Sons, 1888.

Einstein, A. "On the Electrodynamics of Moving Bodies." Special Theory of Relativity, 1970, pp. 187–218., doi:10.1016/b978-0-08-006995-1.50014-4.

Ellis, John, et al. "A Phenomenological Profile of the Higgs Boson." The Standard Model Higgs Boson Current Physics–Sources and Comments, 1991, pp. 24–72., doi:10.1016/b978-0-444-88807-5.50066-2.

Fox, Justin. "What Confederate Monument Builders Were Thinking." Bloomberg.com, Bloomberg, 20 Aug. 2017, www.bloomberg.com/view/articles/2017-08-20/what-confederate-monument-builders-were-thinking. Accessed 21 Aug. 2017.

Gaddis, John Lewis. *The Cold War: a new history*. London: Penguin , 2007. Print.

Heilprin, John. "CERN chief: Higgs boson quest could wrap up by midyear." NBCNews.com, NBCUniversal News Group, 27 Jan. 2013, www.nbcnews.com/id/50601148/ns/technology_and_science-science/#.USVTVx287-Y. Accessed 19 June 2017.

Leuchter, Fred A. The Leuchter-Report: the end of a myth ; an engineering report on the alleged execution gas chambers at Auschwitz, Birkenau and Majdanek, Poland. Toronto, Samisdat, 1988.

Lipstadt, Deborah E. Denying the Holocaust the growing assault on truth and memory. New York, Free Press, 1993.

Medland, William J. "The Cuban Missile Crisis: Evolving Historical Perspectives." *The History Teacher* 23.4 (1990): 433. Web.

Newton, Isaac. Opticks: or a treatise of the reflections, refractions & colours of light. London, Publisher not identified, 1730.

Oerter, Robert. The theory of almost everything: the Standard Model, the unsung triumph of modern physics. New York, Pi Press, 2006.

Plato, and H. D. P. Lee. Timaeus. Baltimore: Penguin, 1965. Print.

Schlesinger, Arthur M. Origins of the cold war. Indianapolis, IN, Bobbs-Merrill.

Sorensen, Theodore C. Counselor: a life at the edge of history. New York, NY, HarperPerennial, 2009.

Staley, Richard (2009), "Albert Michelson, the Velocity of Light, and the Ether Drift", Einstein's generation. The origins of the relativity revolution, Chicago: University of Chicago Press

ESSAY 5 "The production of knowledge seems to require creativity at every stage of the process." Discuss this statement with reference to two areas of knowledge.

Spending my formative years in a restrictive education system, where creativity is stifled – science experiments had their methodology outlined to every detail, and even art classes had instructions resulting in homogeneous products from every student – has made me question the need for inventiveness in producing knowledge. Could creativity stem from reason and intuition, or is it rooted in sense perception and imagination? To what extent is creativity required in innovative cognition in art and natural science? I have selected Art and Natural Science, for they are stereotypically contrasting subjects – Art being associated with imagination and originality, while Natural Science is typically seen as more factual and deductive. This allows for a more differentiated contrast between the requirement for creativity in both subjects. This essay will discuss how creativity is needed at all stages of knowledge production in both Art and Natural Science.

Art is an AOK that is generally seen as a creative medium, but the extent to which it requires innovation can be questioned. Knowledge production in art is seen as the crafting of a masterpiece and personal expression. It can be argued that creativity is not needed at every stage as some artpieces are created through mere observation of our surroundings – a replica of the natural environment in scenic paintings, which does not require much innovation, especially if it does not serve the purpose of reflecting societal conditions or expressing the artist's emotions. In Joshua Shaw's 1818 painting *Seven Hills: An American Landscape**[*],*a picturesque scenery of a calm lake against a backdrop of lush forest mountains is depicted, in a similar style of artists like Bierstadt[†]and Hotchkiss[‡]. The year Shaw painted the tranquil *Seven Hills*, the Seminole wars[§]occurred – the longest battle between the Native American Seminole tribe and the United States Army – brutal bloodshed was rampant, unlike the serenity within the artpiece. Not only was it a mere reflection of the natural world, through sense perception and without creativity, made to resemble reality as close as possible, it also did not serve a social function, nor express Shaw's desolation in his circumstances as an orphan[**]. Thus, creativity is not required in certain forms of art, such as landscape painting, a branch of realism[††], in knowledge production in art.

However, creativity might be needed at every stage as art requires a unique, imaginative perception of the encapsulated source, from deciding on the material to technical preparation, and finally, the crafting of a masterpiece. Out-of-the-box thinking is also required, especially since art has a "predictive power" – the ability to provide inspiration for future technology. Daniel Arsham, a sculptor, "mold(s) static forms that seem to be moving, defying the laws of physics"[‡‡]. Imagination is prevalent within his works – his sculptures encourage both himself and the audience to "rethink expectations about reality and push the boundaries of possibility"[§§]. Since these concepts do not exist, they are a unique, creative product of the artist's mind and the audience's perception, stemming from the warping of observations in the environment with sense perception. This "predictive power" is also evidenced by Stanley Kubrick's 1968 movie A Space Odyssey[***], where he conceptualised a video-calling service like Skype, developed in 2003. It was a collaborative approach breaching physics and art, requiring innovation and imagination to a large extent by a team of "aeronautics specialists, and production designers."[†††]As none of this technology had been developed back then, and was a result of imaginative thinking by the scriptwriters, director and creative team, the formulation of the movie required creativity. Intuition was also seen in the usage of innate technological knowledge, following patterns in the advancement of telecommunications, to conceptualize artistic inventions from the future. Therefore, creativity is needed at every stage of knowledge production in art, and can also stem from intuition, besides sense perception and imagination.

Natural Science forms a contrast with art – the general, albeit cliched, association with it is methodical and uncreative. Knowledge production in Natural Science is taken as the discovery of theories or the usage of it to solve dilemmas. Creativity may not be needed at every stage as Natural Science is factual and conclusions made to produce scientific knowledge are often logical deductions from existing theories or inferences from observations. Mendel's experiments[‡‡‡]on genetic inheritance and hybrid crosses did not require innovation, but rather a rigorous scientific method of mating pea plants and observing the characteristics of their offspring. His data and generation of the Mendelian ratio was not a result of creativity, but keen observation of the organisms around us through sense perception and reason, in order to make sense of these observations. Additionally, the periodic table[§§§]was pieced together by many scientists who worked to find out the various elements that formed part of it. Since they used similar methods of trial and error in order to lead to the completion of the periodic table by building on the work that had been done by scientists prior, there was no creativity, but rather an organized repetition of experiments on reactivity and other characteristics of elements in order to classify them. Sense perception is used by observation of the physical and chemical properties of the elements. Imagination can be seen in a small extent in the generation of hypotheses by Mendel and the chemists, but even then, creativity is not required as they are inferences from existing scientific knowledge and observations, and instead, reason is involved in drawing connections and synergies to formulate scientific conclusions. Thus, creativity is not needed at every stage of scientific knowledge production.

However, creativity might be needed at every stage as science requires innovative thinking in order to come up with hypotheses in areas without prior research, as well as to develop solutions to scientific problems. “The Greek philosopher Anaxagoras[****](ca. 500 – ca. 428 B.C.) was the first to formulate a molecular theory of matter.” Sense perception exists in his method of reasoning and discovery: he observed that “if an object was cut into half repeatedly…at some point a piece so tiny that it could no longer be divided would be reached”,[††††]and it took imagination to relate this to matter in our surroundings. Intuition was seen in the fact that he related this innate knowledge of indivisible units to a model of the invisible atoms, and reason in his deduction of their correlation. Jeff Woolf,[‡‡‡‡]an engineer, made a Folding Bike Helmet after being in a near-fatal crash on his bicycle. He realised a problem with bicycle road deaths – many cyclists don't use helmets because they are heavy and bulky. To solve this dilemma, he invented a lightweight foldable helmet made out of interweavable plastics, through organic chemistry, that is just as strong as traditional helmets, but also flexible enough to be portable. He became a leading name in the field of scientific design and invention, in order to solve everyday problems. Sense perception is seen in his identification of the problem in mounting bicycle road deaths, through observation and personal sensory experience, while imagination is seen in his innovative choice of material for his unique helmets, directed at solving a scientific and social problem. Intuition occurs when he recognises the need for bicycle road deaths to be curbed, building upon the innate knowledge of the harm brought about by road accidents, and reason is seen in both the practical and creative decisions he makes in the production of the helmet. Thus, creativity is needed at every stage of scientific conceptualization, with reason, intuition, imagination and sense perception.

By discussing the extent of the need for creativity in Art and Natural Science with various WOKs like imagination, sense perception, reason and intuition, we can conclude that innovation is needed in most stages of knowledge production. To an artist, creativity might be required at every step of creating an artpiece, because the artist has to conceptualise his art. This refutes the claim that innovation is not needed in landscape paintings, for the artist has to make conscious, creative choices on the angles from which the scenery is painted, and the tools and medium used in his art. This lends claim to the fact that art may require creativity at every stage, especially due to the effect that it may have on its audience of expanding the thought horizon through art. To a scientist, innovation might be seen as an aspect that is irreplaceable in discovery. The claim that science does not require creativity because it only involves observations and deductions from existing theories may be shaky – for it is needed in the processing of data collected and comparing results, in order to make missing links between the experimental data and the logical reality around us. Besides, science also involves knowledge production through crafting experiments and tests to verify claims, often through niche and never-before-seen methods. This supports the claim that creativity is required in every step of production of knowledge in Natural Science as well, through innovative and unique problem solving with the apt use of science. Through the eyes of an ordinary layman, with no in-depth scientific nor artistic knowledge, creativity is arguably needed at every stage in order to produce knowledge from sources of both AOKs. For as audience, our unique perception is what matters when we assimilate and therefore, create our own information from artpieces or scientific claims and experiments, and to form individual opinions on such subjects, a certain level of creativity is needed for personal knowledge production. Thus, creativity is needed at most of the fundamental stages of knowledge production – and it involves sense perception, imagination, reason and intuition amongst many other WOKs.

(1600 words)

Bibliography:

1. "Albert Bierstadt." *Albert Bierstadt*. New World Encyclopedia, n.d. Web. 17 July 2017. <http://www.newworldencyclopedia.org/entry/Albert_Bierstadt>.

2. Allott, Andrew. *Biology: for the IB Diploma*. Oxford, Oxford University Press, 2014.

3. "Anaxagoras." Encyclopedia of World Biography. *Encyclopedia.com.*17 Jul. 2017 <http://www.encyclopedia.com>.

4. Helms, Vann. "American Landscape Paintings of the 19th Century." *Living in The Blue Ridge Mountains of North Carolina- A Blog*. N.p., 18 Sept. 2015. Web. 17 July 2017. <https://blueridgeimpressions.wordpress.com/2012/02/25/american-landscape-paintings-of-the-19th-century/>.

5. Itzkowitz, Laura. "10 New Contemporary Artists Challenging Everything We Knew About Art." *Mic*. Mic Network Inc., 25 Oct. 2015. Web. 27 Apr. 2017. <https://mic.com/articles/85531/10-new-contemporary-artists-challenging-everything-we-knew-about-art#.J790YmMI1>.

6. "Joshua Shaw, Artist and Inventor—The Early History of the Copper Percussion Cap." *Scientific American*. Scientific American, n.d. Web. 17 July 2017. <https://www.scientificamerican.com/article/joshua-shaw-artist-and-inventorthe/>.

7. “Periodic Table History.” *Lenntech*, Lenntech, www.lenntech.com/periodic/history/history-periodic-table.htm. Accessed 19 May 2017.

8. Rhodes, Margaret. “The Amazingly Accurate Futurism of 2001: A Space Odyssey.” *Wired*, Conde Nast, 19 Aug. 2015, www.wired.com/2015/08/amazingly-accurate-futurism-2001-space-odyssey/. Accessed 19 May 2017.

9. "Search Collections." *Smithsonian American Art Museum and the Renwick Gallery*. Smithsonian American Art Museum and the Renwick Gallery, n.d. Web. 17 July 2017. <http://americanart.si.edu/collections/search/artist/?id=2315>.

10. Smith, Justin. "2001: A Space Odyssey Predictions That Became Reality." *Flickfeast*. Flickfeast, 22 Nov. 2011. Web. 28 Apr. 2017. <http://www.flickfeast.co.uk/top-10-2001-space-odyssey-predictions-reality/>.

11. Staff, Time. "Inventions 2016: The Best of This Year." *Time*. Time, 17 Nov. 2016. Web. 28 Apr. 2017. <http://time.com/4572079/best-inventions-2016/>.

12. The Editors of Encyclopædia Britannica. "Anaxagoras." *Encyclopædia Britannica*. Encyclopædia Britannica, Inc., n.d. Web. 17 July 2017. <https://www.britannica.com/biography/Anaxagoras>.

13. "The Seminole Wars." *Florida Department of State*. Florida Department of State, n.d. Web. 17 July 2017.

<http://dos.myflorida.com/florida-facts/florida-history/seminole-history/the-seminole-wars/>.

14. Walker, Jim. "ATOMS (A Short History of the Knowledge of the Atom)." *History of Atoms*. No Beliefs, Nov. 2004. Web. 28 Apr. 2017. <https://www.nobeliefs.com/atom.htm>.

15. "World's Top 10 Best Landscape Artists." *Best Landscape Artists: 1600-Present*. Top 10 Best Landscape Artists, n.d. Web. 17 July 2017. <http://www.visual-arts-cork.com/best-landscape-artists.htm>.

16. Wudka, Jose. "Aristotelian Cosmology." *Aristotelian Cosmology*. Aristotelian Cosmology, 24 Sept. 1998. Web. 28 May 2017. <http://physics.ucr.edu/~wudka/Physics7/Notes_www/node35.html>.

ESSAY 6 "Over time, knowledge has become more accurate." Discuss this statement with reference to two areas of knowledge.

"Accurate knowledge" is knowledge assumed to be correct and valid in accordance with reality. With more information produced over the years, it is intuitive to think that the degree of accuracy of our knowledge will presumably increase too. As the world progresses over time, technological advances are made and knowledge tends to be produced at an increasing rate. Claude C. Hopkins said,"The compass of accurate knowledge directs the shortest, safest, cheapest course to any destination[1]." Thus, not only is it important to educate ourselves with knowledge, it is vital that the knowledge acquired is accurate. This essay will address the progression of the accuracy of knowledge over time, to answer the question whether knowledge in the Natural Sciences and Human Sciences (Economics) becomes more accurate as time progresses. As far as the scope of this essay is concerned, the discussions regarding the knowledge in both Areas of Knowledge will only be whether it becomes more in accordance with reality, not whether the piece of knowledge has actually become perfect.

In the Natural Sciences, knowledge has gained accuracy over time due to the rigor of the scientific method aided by advancements in technology, which reduces the limitations of our sense perception. The scientific method, which is based on empiricism, allows for continuous experimentation and observations on theories made years ago. A more advanced technology comes with a better precision and consistency in acquiring data that eliminates random errors, thus enabling scientists to attain more accurate results. In Biology, we learnt about the changes made to models of the cell membrane over time. In 1935, with the use of the transmission electron microscope, the Davson-Danielli proposed a Tri-Layer cell membrane model – a lipid layer sandwiched by two fixed layers of protein. However, this model was falsified in the 1950s when a more advanced technology such as freeze-etched electron micrographs and fluorescent antibody tracking produced a more accurate observation. Here, a better technology was used to extend the capabilities of our sense perception as a way of knowing so that it was able to perceive what used to be unobservable. Furthermore, in 1972, the Singer-Nicholson proposed a model with mobile proteins embedded in the lipid bilayer – a model that proved to be more accurate[2]. Singer-Nicholson model is based on the new empirical data provided by the antibody staining technique that was not available previously. This example clearly shows that the accumulation of knowledge coupled with more precise instruments is key in enhancing our sense perception as a way of knowing, consequentially making more accurate scientific knowledge available. The continuous reviewing and verification of scientific knowledge, aided by the advancements in technology, allows for falsification of incorrect theories and formation of more accurate ones in the discipline of Biology over time.

However, in some cases of the Natural Sciences, there is an uncertainty in attaining the desired outcome, hence it is presumptuous to assume we gain more accuracy in knowledge over time. A case in point is the discovery of CRISPR-Cas9, which edits the DNA sequence, altering the human genome.[3]It is anticipated to treat genetic disorders by editing the genes of embryonic cells. While it is desired that disease-causing genes are eliminated upon altering the targeted gene, it has been observed that off-target mutations occur when CRISPR-Cas9 modifies other similar DNA sequences.[4]Given that changes in the germline are inherited by future generations, potential off-target mutations are permanent and irrevocable. The scientific method is not applied in this example, as experimentation involves ethical concerns and restrictions. Furthermore, even after unexpected negative anomalies in this genetic modification technique are found, the germline would have already been altered permanently. Hence, there would be generations of people possessing the altered germline. More accurate knowledge about the human DNA and how it behaves under specific gene alterations will not be attainable as CRISPR is not yet allowed to be practiced on humans, resulting in inaccurate knowledge in diagnosis and treatment of genetic diseases. As a result, the knowledge of off-target mutations that may potentially occur in humans, and what could happen, cannot be discovered up until today. In other words, in cases where a scientific research or progress is stunted, more accurate knowledge on the research subject that would otherwise come out of the research would not be attainable.

Economic models and theories which have adapted to the changes in economic climate over time have gained accuracy over time. Unlike the natural sciences, the economy changes constantly as it is largely influenced by human behavior, which is sometimes irrational and unpredictable. Hence, the increase in accuracy is seen in the revision of models that are closer to reality. Furthermore, a wealth of economic models can be used in future "recurring relationships", enabling easier analysis of the economy. Adam Smith, the father of economics, believed that the economy was self-correcting and controlled by pure competition and self-interest, not requiring government intervention.[5]His view contributed to the neoclassical perspective, which believed in consumers' rationality to maximize their utility. However, during the Great Depression in the 1930s, certain claims in neoclassical economics were rejected. John Maynard Keynes built on Karl Marx's view on capitalist societies[6]and produced a theory that justified for government intervention in order to correct short-term fluctuations, pulling the economy out of the Depression. However, in the 1970 recession, the reliance on the Keynesian model led to a stagflation. The New Classical model was then proposed based on neoclassical perspectives, re-focusing the view that macro models should be based on microeconomics.[7]These different economic models and theories allowed for an understanding that is more in accordance with the specific economic climate at different times. Hence, these examples prove that over time, as more models are created, economists have more choices of different models to apply to different scenarios and make more accurate analyses of the economy.[8]

Despite the increased accuracy of economic models, some predictions have not grown in accuracy. All economic predictions, despite their complicity, are subjective representations of reality, designed to explain observed phenomena.[9]The prediction is therefore based on situations that could have contained random variables, such as human psychology and behavior. Many economic behaviors go against the “rational” behaviors predicted by even the most experienced economists. For example, poor existing macroeconomic frameworks, policies and predictions saw the 1998 Asian Financial Crisis. A lax macroeconomic policy caused “disruptions in bank and borrower balance sheets”, inducing widespread bankruptcies.[10]Ten years later, a similar macroeconomic failure is seen again in 2008 Global Financial Crisis[11]and the US subprime mortgage crisis[12]. Prior to that, economists had perceived the economy to be stable and none of the existing predictions foreshadowed a possible crisis occurring. Paul Krugman describes the main reason for the repeat of the Financial Crisis since the Great Depression was economists viewing capitalism and the free market to be the perfect system, forgetting that it was one of the causes of the Great Depression in the first place.This led to economists overlooking possible loopholes in human rationality that resulted in sudden fluctuations in the economy.[13]Additionally, even though macroeconomic framework is used to predict future county-level economic changes, it is still built upon past experiences, employing memory, reasoning and intuition as ways of knowing. Economic predictions are studied based on previous experiences, further emphasizing its inability to predict what has never happened before. Intuition as a way of knowing itself is prone to errors as shown in aforementioned crises. This, together with the unpredictable human psychology and economic behaviors make macroeconomic predictions ever-fallible.[14]Hence, economic predictions sometimes fail to foresee an upcoming crisis over time, evidently suggesting the knowledge in economic predictions does not necessarily get more accurate.

In conclusion, my address to the question is that knowledge generally becomes more accurate in both areas of knowledge as discussed. Despite that, there are still some exceptions in both fields where knowledge does not necessarily become more accurate. The advancement of technology is the factor driving the increase in accuracy of scientific knowledge as shown in the revised cell membrane model over time. Meanwhile, the development of more supplementary economic models is key in making our knowledge in economics more accurate. However, in Natural Science, more accurate knowledge is sometimes not possible especially when the scientific progress such as CRISPR is hindered. Likewise, knowledge in economic predictions may not necessarily get more accurate over time as there have been the similar macroeconomic prediction failures shown from time to time such as the 1998 Asian Financial Crisis, the 2007 Global Financial Crisis and the US Subprime Mortgage Crisis.

All in all, this discussion allows us to distinguish what kinds of knowledge get more accurate over time in the different disciplines. Furthermore, we have also discussed that different ways of knowing are employed in different types of knowledge formulation, resulting in each piece of knowledge having different progressions towards a better accuracy. Just like theories in Natural Science, models in Economics are devised through a sound process of reasoning. With more “data points” and evidences collected over time, this reasoning process will also be constantly revisited. This, together with the possibility of extending the capacity of our sense perceptions, will eventually result in a production of more accurate knowledge. On the other hand, intuition as a way of knowing is vulnerable to human errors. As seen in constant economic prediction failures, human intuition has limited capabilities to foresee the surprises and anomalies in the future. In other words, this also proves that the different ways of knowing also affect whether a piece of knowledge gets more in accordance with reality in due time.

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Reference:

1. “Brent Cornell.” *Membrane Models | BioNinja*, BioNinja, ib.bioninja.com.au/standard-level/topic-1-cell-biology/13-membrane-structure/membrane-models.html. Accessed 20 Aug. 2017.

2. “Claude C. Hopkins Quote:” *Claude C. Hopkins Quote: "The compass of accurate knowledge directs the shortest, safest, cheapest course to any destination." (5 wallpapers) - Quotefancy*, quotefancy.com/quote/1581797/Claude-C-Hopkins-The-compass-of-accurate-knowledge-directs-the-shortest-safest-cheapest. Accessed 24 Mar. 2017.

3. Freedman, David H. "Why Economic Models Are Always Wrong." *Scientific American*, www.scientificamerican.com/article/finance-why-economic-models-are-always-wrong/. Accessed 25 Aug. 2017.

4. "How Did Economists Get It So Wrong?" *The New York Times*, The New York Times, 5 Sept. 2009, www.nytimes.com/2009/09/06/magazine/06Economic-t.html?mcubz=1. Accessed 27 Aug. 2017.

5. Mo, Otieno. "CRISPR-Cas9 Human Genome Editing: Challenges, Ethical Concerns and Implications." *Journal of Clinical Research & Bioethics*, vol. 06, no. 06, 26 Dec. 2015, doi:10.4172/2155-9627.1000253. Accessed 12 Mar. 2017.

6. Ouliaris, Sam. "Economic Models: Simulations of Reality." *International Monetary Fund*, Finance & Development, www.imf.org/external/pubs/ft/fandd/basics/models.htm. Accessed 29 July 2017.

7. Ouliaris, Sam. "Econometrics: Making Theory Count." *International Monetary Fund*, Finance & Development, www.imf.org/external/pubs/ft/fandd/basics/econometric.htm. Accessed 29 June 2017.

8. Pritchard, Justin. "What (or Who) Caused the Mortgage Crisis?" *The Balance*, www.thebalance.com/mortgage-crisis-overview-315684. Accessed 25 Aug. 2017.

9. Shea, Brendan. "Karl Popper: Philosophy of Science." *Internet Encyclopedia of Philosophy*, Rochester Community and Technical College Minnesota Center for Philosophy of Science U. S. A. An encyclopedia of philosophy , www.iep.utm.edu/pop-sci/. Accessed 25 Aug. 2017.

10. Thompson, Derek. "The Irrational Consumer: Why Economics Is Dead Wrong About How We Make Choices." *The Atlantic*, Atlantic Media Company, 16 Jan. 2013, www.theatlantic.com/business/archive/2013/01/the-irrational-consumer-why-economics-is-dead-wrong-about-how-we-make-choices/267255/. Accessed 30 July 2017.

11. Sterland, Barry. "The Asian financial crisis 20 years on: Lessons learnt and remaining challenges." *Brookings*, Brookings, 5 July 2017, www.brookings.edu/opinions/the-asian-financial-crisis-20-years-on-lessons-learnt-and-remaining-challenges/. Accessed 25 Aug. 2017.

12. "What Caused East Asia's Financial Crisis?" *Federal Reserve Bank of San Francisco*, 7 Aug. 1998, www.frbsf.org/economic-research/publications/economic-letter/1998/august/what-caused-east-asia-financial-crisis/. Accessed 25 Aug. 2017.

13. "What is CRISPR-Cas9?" *Facts*, The Public Engagement team at the Wellcome Genome Campus, 19 Dec. 2016, www.yourgenome.org/facts/what-is-crispr-cas9. Accessed 23 Mar. 2017.

14. “Why the Federal Reserve Failed to See the 2008 Financial Crisis: The Role of.” *Economic Sociology and Political Economy*, 19 Aug. 2017, economicsociology.org/2014/10/01/why-the-federal-reserve-failed-to-see-the-financial-crisis-of-2008-the-role-of-macroeconomics-as-a-sensemaking-and-cultural-frame/. Accessed 25 Aug. 2017.

ESSAY 7 IS THE VALUE OF KNOWLEDGE RELATED TO HOW EASY IT IS TO ACCESS? DEVELOP YOUR ANSWER WITH REFERENCE TO TWO AREAS OF KNOWLEDGE.

Knowledge- in its own elusive, unknowable way, lends itself to the frustration of many. How do we access knowledge? How do we determine its value? Knowledge and accessibility are some of the basics of knowledge construction, yet debate persists on these two quintessential features of knowledge and knowing. While this essay does not pretend to contain enlightenment with regards to these long-standing quandaries, it does aim to identify the nature of and evaluate the relationship between these two ideas, ultimately tending towards a deeper understanding of their mutual effect using various WOKs.

Notwithstanding the almost quotidian use of the words ‘value’ and ‘accessibility’, the implications of these words contain layers of complexity that need to be defined.

Firstly, knowledge may be considered valuable when it coincides with our own definitions of value, which differ from person to person and consist of traits a piece of knowledge can possess. These traits could be many things, but the two that this essay will focus on are the knowledge’s perceived proximity to the truth and its applicability, since many other traits may be categorised under one of the two. Secondly, accessibility can be related to how well knowledge may be understood using the perspective of different WOKs. Additionally, accessible knowledge can be defined as that which is easy to interact with, meaning we can consider and evaluate it easily in terms of scope- time, physical size, etc. With the parameters in place, we will now endeavour to understand the relationship by exploring examples in ethics and mathematics.

Since accessibility seems to increase the value of knowledge, a possible knowledge question is: **How does accessing ethical knowledge using reason help us formulate theories about the nature of morality?** Ease of access of knowledge, in this case, is defined by our ability to understand ethics with reason. When this happens, we see that in some cases we can better describe the characteristics of morality, hence allowing us to derive insight to a fundamental meta-ethics question: What are moral values? Since these insights are supported by many, we see that is perceived to be a version of truth, making the knowledge valuable. Henry Sidgwick's investigation into and personal take on utilitarianism[1]illustrates this point well. He believed in ethical hedonism, which states that everyone should work towards maximising happiness for all of humanity[2]. Since good may be equated to happiness, the deductive reasoning for this was that mankind should optimise the amount of net happiness for all of society since an increased quality of life is one of our innate desires. However, this indicated the need for a set of rules to abide by if "good/happiness" is to be achieved. To resolve this, he postulated a system of common-sense morality – a collection of moral rules that we use to make judgements about the character and actions of others[3]. Since the possibility of a common, universal moral code was developed based on a reasoned understanding of ethical hedonism, more people perceive this to be true, increasing the value of knowledge on ethical hedonism. Therefore, accessibility may increase the value of some knowledge.

But it cannot be that only easily accessible knowledge is valuable. **To what extent can knowledge in mathematics can be valuable in terms of applicability even when it is not easily accessible with intuition?**In contrast to the previous example, even though mathematical knowledge cannot be accessed with a significant WOK, it is still valued for its applications. This is evident in Riemann Hypothesis, a mathematical conjecture that came to pass in 1859, and an interesting infinite sum. Basically, Riemann's conjecture proved, using rigorous mathematics, that [4], which is the sum of every single positive integer- an infinite number of them. This is inherently unintuitive. How can the sum of every single positive number give us a negative number? How can a divergent arithmetic series (a summation series in which the next term is larger than the previous term) give us a definite number in the first place? This is a conclusion that directly contradicts many intuitions we have in relation to number series, making the knowledge extremely inaccessible in terms of intuition. This is despite the fact that it has been explained using rigorous proofs that tap on deductive reasoning[5]. However, the fact that this sum has been used extensively in quantum mechanical calculations with results that accurately replicate physical phenomena and may be applied to our world proves to us that the Riemann sum can be applied to give us a means of exploring and producing new knowledge[6]. Hence, we see that this piece of knowledge is valued for its applicability and not because our understanding of it through a WOK leads us closer to an ideal we perceive to be a truth. Therefore, we see that inaccessible knowledge may still be valuable to us.

Now that we have discussed accessibility in terms of our ability to evaluate them using different WOKs, it might be beneficial to consider knowledge that is accessible in terms of how easily we can interact with it.

Using this different definition of accessibility, **does our ability to directly interact with mathematical phenomena help us derive what we perceive to be a more complete set of axioms?**To explain my RLS, mathematical constructs will be treated as entities that exist regardless of our perception or understanding of them. This is otherwise known as a Platonist worldview[7]. To make mathematical constructs and ideas more accessible, we invented systems like numbers and units of measurements so we could interact with these ideas directly. These systems allow us interaction with mathematics that we would otherwise not know how to represent and communicate. This in turn led to us understand concepts with increasing complexity, aiding us greatly in progressing towards a more complete picture of many mathematical constructs. The development of the number line illustrates this well. At first, society needed a way to express physical quantities. In a bid to count, we invented the first set of numbers- natural numbers (1, 2, 3…), otherwise known as positive integers. Once that was established, we then learnt to represent the parts of one whole in the form of fractions (½, ⅓ etc.). This filled up the gaps in between our numbers. This was followed by zero and negative numbers, then imaginary and complex numbers[8]. Taking a closer look at the chronological progression of our number system, we see that the invention of each successive set of numbers is contingent on the existence of the previous set of numbers - we must first conceptualise "one apple" before we can understand "half an apple". After time, these expansions of our number line are almost universally accepted and regarded as axioms, with each addition recognised as a higher level of understanding. Therefore, we see that accessing increasingly complex numbers through direct interaction helps us idealise even more complicated numbers. These new numbers are then treated as axioms, proving that it is perceived as a shift towards truth, and is what makes knowledge of the number system valuable.

However, in ethics, this might not always be the case. Sometimes, ethical knowledge surrounds us but may not always be valued for its applicability. Then, **why is ethical knowledge we can interact with easily not always applicable?**To illustrate, I look towards the Singapore justice system; more specifically, its application of retributive justice, which is punishment inflicted for its own sake once a crime is committed[9]. Many Singaporeans grow up with the notion of retributive justice- Singapore is known for legislation that metes out punishments to those who transgress against the local law. The prevalence of retributive justice makes it an idea that Singaporeans interact with often, making it accessible. Recently, however, the use of retributive justice on drug offenders in Singapore has come under fire[10]. At its most extreme, the punitive measures justified by retributive justice are present in the form of the death penalty. The amount of public discourse and dissension regarding the application of retributive justice as opposed to restorative or procedural justice shows that such punitive measures, for this crime, has no value in terms of applicability in the eyes of many citizens. We may observe that the sustained public outcry is largely reliant on emotion and intuition: in the eyes of many, the death penalty is unnecessarily harsh, and stories from the families of those on death roll have touched the hearts of Singaporeans. Why is this so? Emotion and intuition play an extremely huge role in determining the usefulness of ethical knowledge to us because of the instinctual nature of morality to many of us. Therefore, when retributive justice is unable to illicit a positive emotion reaction from us, we find it inapplicable and hence not valuable.

In conclusion, how does the accessibility of a knowledge relate to its value? When a piece of knowledge is valued for its in-depth insight to our world, we see that there is a need for accessibility so we may better use or understand it. Therefore, for much of this type of knowledge, value is dependent on accessibility. However, when knowledge is instead valued for the tangible gains or its ability to produce an emotional reaction, it is only valued for its ability to do just that- produce utilitarian benefits or illicit a positive emotional reaction. Therefore, its value is no longer heavily dependent on whether it can be accessed but rather how well it can be used as a means to an end.

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BIBLIOGRAPHY

1. *Skelton, Anthony. "Sidgwick's Argument for Utilitarianism and His Moral Epistemology: ..."Revue D'études Benthamiennes, Centre Bentham, 9 Dec. 2013, etudes-benthamiennes.revues.org/675#tocto1n1.*

2. *Weijers, Dan. "Hedonism." Internet Encyclopedia of Philosophy, Internet Encyclopedia of Philosophy,* www.iep.utm.edu/hedonism/.

3. *Frederick, Robert. "WHAT IS COMMONSENSE MORALITY? | Think." Cambridge Core, Cambridge University Press, 13 Oct. 2009,* www.cambridge.org/core/journals/think/article/what-is-commonsense-morality/79DA2FA67E3DAA6F0F7D1BBCC342AC00.

4. *ASTOUNDING: 1 + 2 + 3 + 4 + 5 + ... = -1/12*. Dir. Brady Haran. *Youtube*. Numberphile, 9 Jan. 2014. Web.

5. Frederick, Robert. "WHAT IS COMMONSENSE MORALITY? | Think." *Cambridge Core*. Cambridge University Press, 13 Oct. 2009. Web.

6. Han, Kirsten. "The Mandatory Death Penalty: A Blinkered Policy." *The Huffington Post*. TheHuffingtonPost.com, 11 May 2012. Web.

7. Overbye, Dennis. "In the End, It All Adds Up to – 1/12." *The New York Times*. The New York Times, 03 Feb. 2014. Web.

8. "Platonism and Theism." *Internet Encyclopedia of Philosophy*. Internet Encyclopedia of Philosophy, n.d. Web.

9. *The Riemann Integral*. N.p.: U of California, Davis, n.d. *Math; UC Davis*. University of California. Web.

10. Skelton, Anthony. "Sidgwick's Argument for Utilitarianism and His Moral Epistemology: ..." *Revue D'études Benthamiennes*. Centre Bentham, 09 Dec. 2013. Web.

11. Weibull, Nikolai. "An Historical Survey of Number Systems." (n.d.): n. pag. Print.

12. Weijers, Dan. "Hedonism." *Internet Encyclopedia of Philosophy*. Internet Encyclopedia of Philosophy, n.d. Web.

ESSAY 8

Given access to the same facts how is it possible that there can be

Disagreement between experts in a disciplineø Develop your answer with

Reference to two areas of knowledge

As a young adult fascinated by the controversy of the political world, the recent US elections have sparked some interesting considerations. Speeches given by the presidential candidates have highlighted to me that society's understanding of expert opinion is heavily influenced by the sense of trust which citizens place in their politicians. Never before had I experienced political discourse so riddled with logically flawed arguments and the notion of 'alternative facts'. This led me to question how facts are evaluated by experts, and how it is possible that the same facts can merit conflicting interpretations. I began to notice that even within a single discipline, experts evaluate facts differently and arrive at different conclusions. So, with access to the same facts, how does expert disagreement occur, and to what extent is it necessary in the production of knowledge?

To begin, we can define an expert as a practitioner with a particularly advanced skill set or knowledge base in a discipline; earning their title through both education and experience. Facts are used by experts as a source of evidence for a claim or theory and are often dependent on interpretation. For example, the number of deaths after the Fukushima nuclear meltdown will vary whether considering immediate deaths, deaths from background radiation, or long-term radiation poisoning. Consequently, experts' differing interpretation of facts can lead to disagreement. We can explore this subtlety further by considering factors which lead experts to disagree in History and the Arts.

Historical experts often disagree because of differing schools of thought and ideology. Historians generally associate with a school of thought which aligns with their interpretive style and reasoning process.1 For example, German philosopher Martin Heidegger was an extremely prominent lecturer in the 1920's and fervently supported the Intentionalist "Fuhrer Principle"; that Hitler's unique leadership skills were imperative to the Nazi regime2. Heidegger's students, such as Hans Jonas, were strongly influenced by his mentorship and later built upon his work in their own research. On the contrary, right-wing Functionalist historian Hans Mommsen disagreed with this interpretation and believed the Nazi regime was fueled by the German zeitgeist3. This suggests that a historian's ideology influences their interpretation of facts, and further that the production of knowledge can be strongly coloured by the teachings and prominence of intellectual figureheads. Therefore, it is imperative to be conscious of an expert's background when evaluating experts' theories, and perhaps to consult a wider range of information. Although opposing ideologies exist, historians also endeavour to establish a common basis of agreement on the broader interpretations of historical events; and this process is required to legitimise the production of historical knowledge. As historians have uncovered more information about Heidegger's nationalistic influences, his teachings have become increasingly disregarded and the Intentionalist school of thought has adapted accordingly. Resultantly, historians continue to scrutinise fellow experts' theories and shared historical knowledge develops over time.

Historians may disagree not only because of their ideology but also due to the nature of historical research. Making the assumption that no historian can consider every available primary and secondary source from a historical event, historians use Reason to discern a gradation of factual significance. However, historians' research is often guided by their branch of historical study. When exploring key factors in the decline of Mayan civilisation, expert James Baldini pointed to climate conditions4, whereas historian Mark Cartwright identified issues of social conflict. As a geophysical historian, Baldini prioritised the study of geographical factors, whereas cultural historian Cartwright believed social relationships between Central American tribes were of greater impact5. This process of factual prioritisation therefore leads to disagreement between experts and is inherent in historical study. However, experts may also be obligated to intentionally†prioritise certain historical facts to shape history to certain socio-political beliefs. A pertinent example is South Korea’s proposition to change its history textbooks. South Korean minister Kim Jae-Choon believes that certain history textbooks “ fail to make it clear that the Korean War was started by the North”6. History professor Chung-in Moon disagrees, praising textbooks for providing “multiple interpretations”7 . This highlights that the production of historical knowledge is not solely determined by independent historians, but also by those working in governments and institutions. The implication of this is that knowledge in history is not solely the product of experts’ intellect but also by systems of patronage, and hence we must not assume that all knowledge produced by experts is based purely on their personal interpretations.

Although experts from differing branches of history prioritise different facts, this divergence can, in fact, be beneficial for the production of knowledge. When historians explore different aspects of history, the circulation of conflicting interpretations can improve our understanding of historical events. For example, the negative impact of British colonialism in India has long been a disputed topic. Historian Samuel Osborne stresses that regional instability was caused by Cyril Radcliffe’s decision to partition British-India based on religion8. However, such negative interpretations of British colonisation have more recently been reconsidered, with historian Kartar Lalvani emphasising the long-term value of “English law and language” and the formation of a “unified India”9. When a disagreement exists between experts, they search for new information to justify and challenge existing theories. Although Lalvani’s interpretation contradicted prior interpretations of British occupation, it has contributed to the exploration of colonial infrastructure as a successful platform for India’s development. So perhaps expert disagreements can stimulate the inquisitive nature of historical study and allows experts to consider different perspectives.

Disagreement among experts is also evident within the Arts, particularly of the factors by which experts judge the quality of artwork. We can make the assumption that there are norms†within the Arts for classifying the quality of art. Arguably the most prestigious visual art exhibition of the 1800's, Salon de Paris displayed the region's greatest artworks as determined by founder Cardinal Mazarin and the Salon jury10. However, works from artists such as Edouard Manet were rejected by the Salon as they did not emulate traditional norms of religion and realism. These artists went on to establish the Salon des Refusés, which housed many now-famous works such as Manet's "Le Déjeuner sur l'herbe"11. Although these works were rejected by the most distinguished panel of experts, it is ironic that many of these paintings have left a greater legacy than those acknowledged by experts from the Salon. This highlights that a time period's norms for classifying 'good art' are not necessarily absolute, and experts' conformity to traditional norms†can discourage the development of progressive, avant-garde styles; limiting the production of knowledge.

This also raises the consideration of whether experts are influenced by their peers when defining 'good art'. Experts often judge art by Emotion and explore how a piece of art can provide insight into human nature. However, neutrality in the assessment of art is very difficult, and experts are often inadvertently influenced by external factors. For example, renowned author of the Harry Potter series, J.K Rowling, decided to publish The†Cuckoo's†Calling†under the pseudonym Robert Galbraith. Many major publishing agencies turned the book down, with publishing director Kate Mills stating it "didn't stand out"12. Yet after its publication and reveal of Rowling as the novel's author, the reception by literary critics was transformative. Critic Declan Burke then described the novel as, "one of the most assured and fascinating debut crime novels"13. This suggests that experts' perception of artwork can be influenced by the perceived credibility of its creator, and disagreements can occur depending on whether experts consider the merit of the work itself or their preconceptions of the artist/author.

In addition, experts disagree on the quality of an artwork based on their cultural and moral context. When Language is used to explore issues of ethics and morality, as in disciplines such as Literature, there are often stark differences in expert interpretation. For example, the gripping novel Lolita, by Vladimir Nabokov, describes a self-indulgent man who is sexually infatuated with teenage girls; raising issues of paedophilia and sexual morality. Banned in five countries, editors of The New Republic published an article describing Lolita as an "obscene chronicle of murder and a child's destruction". Conversely, critic Thomas Molnar noted after the book's release in 1955 that the novel had "a brilliance which may yet create a tradition in American letters."14 It is evident that Molnar's cultural paradigm differed from those of The New Republic, and illustrates that experts' perception of Art can be strongly guided by their moral background. However, it appears that society's broadening moral context has shifted away from traditional values, and the novel is now widely regarded as a literary masterpiece.

Having explored both History and the Arts, it is evident that experts' interpretation of the same facts can often lead to disagreement, and similar ways of knowing do not always merit the same conclusions. However, given that experts are unique individuals from all around the world, is it ever fair to assume that experts are armed with the same facts? A primary source of disagreement between experts arises due to different access to facts, and these inherent differences often complement the production of knowledge. The production of knowledge is largely dependent on disagreement as a platform for curiosity and exploration, and flourishes when new interpretations both challenge and confirm existing models and theories. Whether explaining the past through History or exploring human nature through the Arts, knowledge is founded upon the complexity of human-beings and benefits from debate between a diverse range of engaged experts. So perhaps the production of knowledge should be founded upon the intellectual process of expert disagreement rather than a blissful pursuit of consensus.

Word Count 1596

References

● Burke, Declan. "The Cuckoo's Calling, By Robert Galbraith", 2013. http://www.irishtimes.com/culture/books/the-cuckoo-s-calling-by-robert-galbraith-1.1475081?page=1.

● Cartwright, Mark. "The Classic Maya Collapse", 2014. http://www.ancient.eu/article/759/.

● Evans, Stephen. "Why South Korea Is Rewriting Its History Books". BBC†Asia, 2015. http://www.bbc.com/news/world-asia-34960878.

● Henly, Carolyn and Nicholas Alchin. Theory†Of†Knowledge. 3rd ed. London, United Kingdom: Hodder Education, 2014.

● Inc, Time. "The 'Lolita' Case", 1999. http://content.time.com/time/magazine/article/0,9171,22369,00.html.

● Jackson, Matthew. "Historians' Debate: The Historikerstreit And The Search For National Identity In Post-War Germany", 2017. http://www.academia.edu/8786591/Historians_debate_The_Historikerstreit_and_the_search_for_national_identity_in_post-war_Germany.

● Kimball, Jeffrey. "The Influence Of Ideology On Interpretive Disagreement: A Report On A Survey Of Diplomatic, Military And Peace Historians On The Causes Of 20Th Century U. S. Wars". The†History†Teacher†17, no. 3 (1984): 355-384. doi:10.2307/493146.

● Lawson, Mark. "The Cuckoo's Calling By Robert Galbraith – Review". The Guardian, 2017. https://www.theguardian.com/books/2013/jul/18/cuckoos-calling-robert-galbrai th-jk-rowling-review.

● Lee, Adrian. "Home". UK, 2013.
http://www.express.co.uk/news/uk/409374/The-Remarkable-Raj-Why-Britain-should-be-proud-of-its-rule-in-India.

● Oltermann, Philip. "Heidegger's 'Black Notebooks' Reveal Antisemitism At Core Of His Philosophy". The†Guardian, 2017.
https://www.theguardian.com/books/2014/mar/13/martin-heidegger-black-notebooks-reveal-nazi-ideology-antisemitism.

● Osborne, Samuel. "5 Of The Worst Atrocities Carried Out By The British Empire". The†Independent†≠†Home†News, 2017.
http://www.independent.co.uk/news/uk/home-news/worst-atrocities-british-empire-amritsar-boer-war-concentration-camp-mau-mau-a6821756.html.

● Prescott, Orville. "Books Of The Times". Accessed 2 March 2017.
http://www.nytimes.com/books/97/03/02/lifetimes/nab-r-booksoftimes.html.

● Prigg, Mark. "Did Climate Change Cause The End Of The Maya? Researchers Find Telltale Signs Of Drought That May Have Caused Its Collapse". Daily†Mail, 2012.
http://www.dailymail.co.uk/sciencetech/article-2230034/Did-climate-change-cause-collapse-Mayan-civilisation.html.

● "Salon | French Art Exhibition". Encyclopedia†Britannica, 2017.
https://global.britannica.com/art/Salon-French-art-exhibition.

● "Salon Des Refuses | French Art Exhibition". Encyclopedia†Britannica, 2017.
https://global.britannica.com/art/Salon-des-Refuses.

● Sang-hun, Choe. "South Korea To Issue State History Textbooks, Rejecting Private Publishers". Asia†Pacific, 2015.
https://www.nytimes.com/2015/10/13/world/asia/south-korea-to-issue-state-history-textbooks-rejecting-private-publishers.html.

● Wyatt, Daisy. "How JK Rowling Was Revealed As The True Author Behind The Robert Galbraith Novels". The†Independent†≠†Features, 2010.
http://www.independent.co.uk/arts-entertainment/books/features/how-jk-rowling-was-revealed-as-the-true-author-behind-the-robert-galbraith-novels-a6696576.html.

ESSAY 9 "*Over time, knowledge has become more accurate." Discuss this statement with reference to two areas of knowledge.*

The idea that "over time, knowledge has become more accurate" points to an idealised concept held by society that each generation of knowers has had a better understanding of knowledge than preceding generations. As a young adult deeply intrigued by political discourse, recent events including the EU referendum and the US presidential election have led me to question the validity of this idea in the context of the so-called 'post-truth era' that we live in. Accuracy can be defined as the extent to which knowledge correctly describes observations and findings, and is free from errors. This essay will explore the validity of the statement by considering the development of knowledge production methods and the role of sense perception, reason, faith and imagination in shaping knowledge of the Natural Sciences and History.

Given the rapid inflation of scientific knowledge in recent years, the Natural Sciences is widely considered a dynamic discipline – one where knowledge is subject to change as 'false' knowledge is discarded and more accurate knowledge of natural phenomena is gained. I have personally been made aware of the fluid nature of science: new evidence discovered earlier this year has shown how atomic spins evade the Heisenberg Uncertainty Principle – a principle taught in class as part of the 2016 IB Chemistry syllabus – allowing researchers at the Institute of Photonic Sciences in Barcelona to formulate an approach to estimate the spin precession rate of a particle, thus demonstrating that the position and momentum of a particle at any given moment can be determined more accurately than previously thought.[1]

Recent years have seen the development of reasoning methods and improvements in methods of sense perception (such as the use of higher-grade measuring devices), giving rise to a more accurate method of obtaining scientific knowledge. As early as the 20thcentury, scientist Roger Bacon stressed the need for a systematic experimental knowledge of natural phenomena, stating that "All things must be verified by experience." He wrote that, while reason and experience can help discover the truth, only the latter can remove doubt and introduce certainty.[2]The scientific method has since become more sophisticated, allowing for the development of methods of eliminating errors. For instance, to estimate and tame random observational errors and thereby arrive at more accurate data, Gauss proposed and justified the method of least squares which assumed that erroneous data subject to random errors were probabilistically and symmetrically distributed about the 'true' value.[3]The introduction of measuring devices has allowed for measurement of physical quantities that were previously only were observable by direct sense perception or existed as hypothetical concepts. In 2016, an experiment led by researchers at California Institute of Technology and Massachusetts Institute of Technology involved observation of gravitational waves using Laser Interferometer Gravitational-wave Observatory (LIGO) detectors. Their findings confirm a hundred-year-old hypothesis made by Albert Einstein, who described the concept of gravitational waves when introducing his general theory of relativity. The observation of gravitational waves validates this theory and is to be used as a basis for further research into space phenomena,[4] to enhance the accuracy of available knowledge on the subject.

However, improved reasoning methods are not infallible and may lend themselves to inaccurate conclusions. Statistical inferences based on appropriate methods do not necessarily provide accurate knowledge and usually require theoretical and causal understanding of the topic investigated. Gauss, when explaining the limitations of his method of taming random errors, repeatedly stressed that "resource to judgment was indispensable in separating the gold from the dross among variable observations".[3] Relying on statistical methods alone is therefore not sufficient to validate a prediction.

Conflicts of interest in publishing scientific reports may also hinder the production of accurate scientific knowledge over time. The motivation for scientific study may not always involve the pursuit of accuracy. Consider the infamous 1998 paper published in the *Lancet*by Andrew Wakefield, which suggested a link between the MMR vaccine and developmental issues in children. The paper received widespread publicity and resulted in falling vaccination rates as an increasing number of parents were concerned about the risks of vaccination. Immediately afterward, epidemiological studies were conducted and refuted the conclusions presented in the 1998 paper by demonstrating that there was no link between the MMR vaccine and developmental issues. The *Lancet* later revealed that Wakefield had not disclosed his financial interests in publishing the aforementioned conclusions.[5] Despite extensive evidence showing that there is no causal link between vaccines and developmental issues in children, the last decade has seen an *anti-vaccine movement*, wherein an obstinate minority of people claim otherwise, dismissing the findings of studies that discredited Wakefield's 1998 paper.[6] There are countless such examples of pseudoscience being practiced, including climate change skepticism and the practice of palmistry – begging the question: what distinguishes nonscience or pseudoscience from accurate scientific findings? Philosopher of science Massimo Pigliucci wrote, “the boundaries separating science, nonscience, and pseudoscience are much fuzzier and more permeable than Popper [..] would have us believe”.[7]The scientific method would require sufficient empirical evidence to validate a scientific theory; however, theories might prevail even in the absence of such evidence. Anti-vaxxers, for instance, subscribe to the idea that vaccines lead to developmental issues in children, based on observation and faith. This highlights how the process of induction is problematic: a vaccinated child displaying symptoms of autism is not sufficient evidence to indicate a correlation, but faith may be used to bridge the gap between lacking evidence and the conclusion that there is a link between vaccines and the incidence of autism.

Over time, there has been an increase in technologies that preserve historical information, allowing historians easier access to source material. As new source material becomes available, we gain enhanced understandings of events that took place in the past. New evidence may allow historians to better come up with a logical progression of historical events or discard accepted knowledge about a historical event or time period. In 2009, evidence from carbon dating of rocks found in the Karoo Basin in South Africa revealed that that the *Dicynodon*– a species whose fossil records define the Permian-Triassic Extinction – disappeared about a million years before the Extinction is believed to have taken place.[8]Carbon dating is yet another example of how technology has allowed us to avail of more accurate knowledge.

On the other hand, the different ways in which historians apply reason to compile historical information may lead to different historical accounts with questionable accuracy. Given the plethora of source texts available – some of which may convey details that contradict each other – a historian must use reason to determine the veracity of source material, and then use selected source material to come up with a plausible sequence of historical events. A notable epistemological weakness of historical knowledge is that different approaches can be applied to selection and interpretation of source material, leading to different explanations of past events, all of which may be *justifiable* according to different historians. The process of sorting and sifting through evidence and determining what to accept as reliable evidence inextricably ties up the historian's viewpoint to the knowledge he or she will convey.

Even a wealth of reliable source material may fail to provide a complete picture of past events, thus hindering our understanding of them. Humanities Professor Goodman wrote that writers do not write merely to report but rather because they have something significant to report, and we are thus given "a distillate of a lifetime's thought and experience".[9] When evidence falls short, historians often use imagination to 'fill in the gaps', and it is difficult to evaluate the accuracy of such knowledge.

Additionally, the reporting of History may not necessarily fulfill the objective of discarding erroneous knowledge in favour of more accurate knowledge. An example of this would be the destruction of historical evidence, which typically is caused by actions committed due to dogmatically-held ideologies or for profit. The Chinese Cultural Revolution initiated by Mao Zedong, which took place from 1966 to 1976 and aimed at promoting the concept of equality as well as creating a new socialist culture, involved large-scale destruction of capitalist elements of Chinese society as a Communist government came into power, thus destroying much of historical evidence of life in China before the Communist regime prevailed.[10] Today, there is little historical knowledge on pre-Communist China, as a result of shared historical knowledge being shaped by the interests of governments and institutions rather than those of people who lived in the past and documented what would become historical evidence. The personal knowledge of people who lived in pre-Communist China is likely to be more accurate than shared knowledge on the time period reported in textbooks, possibly resulting in a loss of accuracy of knowledge propagated to future generations.

Scientific and historical knowledge has been *on the move*, with several established concepts being eroded and replaced by new ones. In evaluation, prevailing ideas may not always be replaced by more accurate knowledge, even with improvements in knowledge production methods. While time has allowed for significant breakthroughs and discoveries, there are instances where it is difficult to determine what constitutes false knowledge and should be discarded in favour of 'more accurate' knowledge. Not all knowledge can be supported by hard, rationally-presented evidence. In such cases (and even otherwise), personal and shared knowledge may not necessarily be accurate and we rely largely on faith to accept theories and laws, possibly leading to general misinformation rather than accuracy. As far as possible, it is important to evaluate the accuracy of knowledge conveyed by examining the underlying evidence for a conclusion as well as considering any vested interests experts may have when imparting knowledge.

[1,600 words]

Bibliography

Carey, Bjorn. "Stanford Scientists Celebrate Technological Advances That Made Gravitational Wave Detection Possible." *Stanford News*, Stanford University, 7 Apr. 2016, news.stanford.edu/2016/02/11/scientists-celebrate-advances-021116/.

Daston, Lorraine, and Glenn W. Most. "History of Science and History of Philologies." *Isis*106.2 (2015): 378-90. Web. 19 May 2017.

Goodman, Lenn Evan. "Ibn Khaldun and Thucydides." *Journal of the American Oriental Society* 92.2 (1972): 250-70. Web. 19 May 2017.

Hochberg, Herbert. "The Empirical Philosophy of Roger and Francis Bacon." *Philosophy of Science* 20.4 (1953): 313-26. *JSTOR*. Web. 19 May 2017.

Newbury, Sophy. "Geologic Findings Undermine Theories of Permian Mass Extinction Timing." *Geologic Findings Undermine Theories of Permian Mass Extinction Timing | NSF - National Science Foundation*. National Science Foundation, 2 Mar. 2009. Web. 19 May 2017.

Novella, Steven. "The Anti-Vaccination Movement." *The Committee for Skeptical Inquiry*. N.p., Nov.-Dec. 2007. Web. 6 June 2017.

Pigliucci, Massimo. “So, What Is Science after All?” *Nonsense on Stilts: How to Tell Science from Bunk*, University of Chicago Press, 2013, pp. 394.

Rao, Ts Sathyanarayana, and Chittaranjan Andrade. "The MMR Vaccine and Autism: Sensation, Refutation, Retraction, and Fraud." *Indian Journal of Psychiatry* 53.2 (2011): 95. Web.

Vasilogambros, Matt. “The Cultural Revolution's Legacy in China.” *The Atlantic*, Atlantic Media Company, 16 May 2016.

Worgan, Tim. “Atomic Spins Evade Heisenberg Uncertainty Principle.” *Scientific American*, ChemistryWorld, 31 Mar. 2017.

Essay 10 ***Over time, knowledge has become more accurate." Discuss this statement with reference to two areas of knowledge.***

With the need for more critical analysis of knowledge, accuracy plays an important role in most of the areas of knowledge, so that the production and sharing of knowledge will not be misunderstood. Overtime, it is traditionally believed that knowledge develops towards more precision and infallibility. In this context, accuracy is generally defined as "the quality or state of being correct or precise"[1]. How do we obtain and guarantee this accuracy in Sciences and History? Can the methods used in both disciplines ensure more accuracy over time? If not, what are the possible obstacles? In this essay, I will discuss whether this general opinion is true or makes sense and will show what the possible contradictions are.

Through the ages, knowledge in natural sciences becomes more certain due to the fact that there are more developed methods of experiment, technological advancements, and new ways of verification. How can these justify that knowledge becomes more correct? In the natural sciences, accuracy is known as "the degree to which the result of a measurement, calculation, or specification conforms to the correct value or to the standard"[2]. As scientists are offered with more advanced equipment for experimentation, they can make better use of induction (which is based on a strict observation of the reality followed by hypothesis drawn from it). Enhanced instruments enable them also to find out possible errors in the theories which were discovered in the past so that scientists can improve them in more accurate versions. For example, the actual shape of the Earth was a controversial question implying unverifiable myths and all we knew was that it might be a spherical object[3]. However, the truth would only be revealed thanks to the accumulation of previous knowledge and evidences. In the early years of 6th century BCE, some Greek philosophers attributed the Earth to a spherical object since they observed that the moon appeared as a spherical shape. Also, in the 4th century BCE, Aristotle claimed that he could imagine the curved appearance of the earth shadow on the Moon during a lunar eclipse, therefore people got to know some of the first evidences of the spherical shape of the Earth. Furthermore, in the 3rd century BCE, the mathematician Eratosthenes used a tall tower's shadow casted in Alexandria to infer the shape of the Earth. He then deduced that the surface of the Earth is curved as he calculated obviously accurate estimation of planet's circumference, which was based on the observations and the measurement of the shadow length and distance. As the result, the Earth is proven to have a spherical shape after Apollo 8 astronauts sent back some pictures of it from space in 1968. In this case, we can say that the scientists were using the process of scientific reason for their conclusion as empirical evidences helped to solidify what seemed mere conjectures. Time provided a platform through which more findings could be accumulated, and these enabled greater verification that discarded previous conjectures and surfaced more accurate worldview would surface.

Yet, can we say the same about history? Overtime, historical knowledge becomes more accurate since there are more findings, evidences for better corroboration, in order to piece together fragments of the past. Historical accuracy is also known as historicity, which is "the historical actuality of persons and events, meaning the quality of being part of history as opposed to being a historical myth, legend, or fiction"[4]. Thanks to the development of the technology, researchers have better conditions for their confirmation in verifying, checking the credibility of the knowledge or theories. Thus, they will be more confident in their assumption. For example, the truth about Napoleon's death was shown when the researchers took part in the investigation[5]. In the past, people widely believed that Napoleon died because of arsenic poisoning by the guard during his exile in South Atlantic. However, the debate over Napoleon's death has been lasting for nearly 200 years until researchers at Italy's National Institute of Nuclear Physics carried out his DNA testing. After the loss in the Battle of Waterloo, his death was claimed as the result of getting poisoned by the guard in 1961 as they found there was a high level of arsenic in Napoleon's hair though the autopsy did not show any evidences of poisoning. The DNA based testing uses radiation within the reactor has shown his hairs (including the one from his childhood, during his exile, on the day of his death and the day after his death) have mostly same traces of arsenic. Though these levels were up to 100 times more than the hair nowadays, it was common among people in his era. Scientists were really confident with their results, and they suggested that he might have died because of stomach cancer as a result of poor diet for a long term. The reason for their conclusion is that a lot of sailors relied on salt-preserved food, fruits and vegetable during their long journeys at sea. In this case, the wrong prediction of the event in the past was a result of the lack of appropriate method or investigation, causing the shared knowledge less accurate. The emergence of new data and artifacts over time indeed helped to piece together historical truths without simply depending on memory alone. Since the craft of the historian required cross-referencing between old and new data, it is only through the passing of time and the attainment of a greater variety of evidences that historical facts can be constructed.

Although it seems that time may provide with more accuracy, we also observe that knowledge in Natural Sciences still remains uncertain, as predictions happen to be deceptive.

Though modern technologies and new exploratory methods are available, these still may not evolve towards greater precision in light of unpredicted events or uncertainty. For example, six Italian scientists were sentenced to six years in prison after the 2009 deadly earthquake in Italia in 2012 as they gave a falsely reassuring statement to the public[6]. The judge claimed that the scientists provided "imprecise, incomplete and contradictory information" and effectively "thwarted the activities designed to protect the public”. Though the decision was made, someseismologists around the world went to argue that it was impossible to predict earthquakes and that no major tremor was observed. In this case, how far can we trust that scientific knowledge always points towards greater certainty? Science is still at this point unable to predict natural phenomena with the desired accuracy, despite being the backbone of the scientific endeavor.

In History, many factors can indeed affect the accuracy of the knowledge. Time is one of them, as memory and availability of data fade over time. Falsifications of data, miscommunication or biased information on events are examples of the inevitable loss of knowledge that occurs over time. Though the modern world allows people to check credibility more easily, using all sorts of online news sites or internet libraries, the historical events in the past can be forged, edited or simply misinterpreted. Shared knowledge influences personal knowledge, and people are prone to leave their beliefs, emotions and imagination, color their understanding of the past. Moreover, researchers have more opportunities to find more evidences of past events, leading to new interpretations, which results in controversy. For example, we can think of the truth about who discovered America, which is an unresolved debate between the Chinese and Europeans[7]. Most of us have been taught in school that Christopher Columbus was one of the discoverers of the world. However, some historians claim that it is more accurate to say he introduced America to Western Europe and was one of the last explorers to reach America. In the sixth century, an Irish Monk instead was supposed to sail to North America on a currach, but there is no obvious evidence that he made landfall in this area. Furthermore, in the tenth century, the Vikings team of explorer Leif Erikson sailed to a place he called “Vinland”, which is now the Canadian province of Newfoundland. Many scholars documented and accepted this as historical facts, but there was no proof of Erikson’s American sojourns. In the fifteenth century, Zheng He sailed to the east coast of the United States and probably had established settlements in South America. Also, the Chinese ceramics in Ming dynasty found in America, which were purported to be part of Zheng He’s fleet, gave the Chinese reason to claim that they were the once instead who discovered the world. From the above example, though the work of Columbus is well-accepted, the terrain of who discovered the world continues to be fraught with the political contest, as the emergence of new and more evidences through time gave more people reason to claim credit for this discovery. In this case, historical knowledge is uncertain as different interpretations and controversies co-exist, leading to endless debates about the truth. Therefore, knowledge of history does not necessarily become more accurate ultimately over time with the rise of more evidences.

What, then, can we conclude about the role of time in creating more accuracy in historical and scientific knowledge? From my examples, knowledge can be more or less accurate, due to an interplay of many perspective and external factors. In general, scientific knowledge, though with its limitations, tends to evolve to become more accurate, since strengthening the veracity of past theories is at the heart of the scientific endeavor. Yet, on the other hand, more evidences may also be a double-edged sword in the historical context, serving to blur the lines between fact and fiction in constructing knowledge of our world.

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Bibliography

"Accuracy - definition of accuracy in English | Oxford Dictionaries." Oxford Dictionaries | English, Oxford Dictionaries, en.oxforddictionaries.com/definition/accuracy. Accessed 23 Aug. 2017.

Carpi, Ph.D. Anthony, and Ph.D. Anne E. Egger. "Visionlearning.com." Visionlearning, Visionlearning, Inc., 11 Feb. 2017, www.visionlearning.com/en/library/Process-of-Science/49/The-Nature-of-Scientific-Knowledge/185. Accessed 23 Aug. 2017.

"Historicity." Wikipedia, Wikimedia Foundation, 15 Aug. 2017, en.wikipedia.org/wiki/Historicity. Accessed 23 Aug. 2017.

"The Truth About Napoleon's Death." International Biosciences UK The Truth About Napoleons Death Comments, www.ibdna.com/truth-about-napoleons-death/. Accessed 23 Aug. 2017.

Edwin CartlidgeFeb. 10, 2015 , 3:15 PM, et al. "Why Italian earthquake scientists were exonerated." Science | AAAS, 26 July 2017, www.sciencemag.org/news/2015/02/why-italian-earthquake-scientists-were-exonerated. Accessed 23 Aug. 2017.

Weiner, Eric, and Russell Freedman. "Coming to America: Who Was First?" NPR, NPR, 8 Oct. 2007, www.npr.org/templates/story/story.php?storyId=15040888. Accessed 23 Aug. 2017.

Enochs, Kevin. "The Real Story: Who Discovered America." VOA, VOA, 10 Oct. 2016, www.voanews.com/a/who-discovered-america/3541542.html. Accessed 23 Aug. 2017.

Klein, Christopher. "The Viking Explorer Who Beat Columbus to America." History.com, A&E Television Networks, 8 Oct. 2013, www.history.com/news/the-viking-explorer-who-beat-columbus-to-america. Accessed 23 Aug. 2017.

"Accuracy - Definition of Accuracy in English | Oxford Dictionaries." *Oxford Dictionaries | English*, Oxford Dictionaries, en.oxforddictionaries.com/definition/accuracy.