

Elucidating the Certainty Uncertainty Principle for the Social Sciences: Guidelines for Hypothesis Formulation in the Social Sciences for Enhanced Objectivity and Intellectual Multi-Polarity

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Abstract:- This paper is the second in our series on scientific method for the social sciences, and is presented in relation to what we call the “Globalization of science”. It is like our earlier works, designed to provide multi-vocality and multi-polarity to the sciences, and discourage Eurocentrism or any other form of ideology or centrism. It uses existing theories on uncertainty and incompleteness as a starting point and further utilizes them to construct an approach that can be used chiefly in the social sciences, but also in the other sciences, albeit to a smaller extent and degree. Our first paper on scientific method delineated “the sociological ninety-ten rule”, and the principle of what we called exceptionism, while this paper weighs the twin concepts of certainty and uncertainty in relation to each other, to evaluate hypothesis and paradigms in science. The papers also discuss various avenues for the misuse of science, with data and evidence culled from various disciplines, and contexts, and suggests various methods to curb, and mitigate unwanted tendencies, and proposes concepts such as ‘cross-cultural research design’, which are in keeping with the ideals accumulated in our previous papers. Our paper also discusses and revisits other concepts such as the idea of “fuzzy logic” as can be applied to the social sciences, besides the philosophy of neo-centrism and the theory of paradoxes. All these ideas and ideals, we fervently hope will serve the cause of science well, by leading to better quality of scientific endeavour developed with data collected from diverse social and cultural contexts all over the world, and serve the cause of society much better.

I. INTRODUCTION

This paper is the second in our series on scientific method, and is presented in the context of what we have called the “Globalization of science” particularly the social sciences, and is like our earlier work, designed to provide multi-vocality and multi-polarity to the sciences, and discourage Eurocentrism or any other form of ideology or centrism. It uses existing theories on uncertainty and incompleteness as a starting point (to also draw a humorous analogy, since these theories are somewhat different from each other, and our work draws only a limited inspiration from them!) and further utilizes them to develop a new approach that can be used chiefly in the social sciences, but also in the other sciences, albeit to a smaller extent and degree. Our first paper on scientific method delineated “the sociological ninety-ten rule”, and the principle of what we called exceptionism, while this paper weighs the twin

concepts of certainty and uncertainty in relation to each other, to evaluate hypothesis and paradigms in science. We also strongly argue that identifying uncertainties in hypotheses (and evaluating them in relation to certainties or certain factors), theories and paradigms must become a mindset, just as we argued that exceptionism must become a mindset. These would serve the twin concepts of reliabilism and the universal applicability of scientific endeavour very well, indeed.

This paper also discusses already existing ideas on uncertainty, as propounded by scientists such as Werner Heisenberg in 1927, and the incompleteness theorem proposed by Kurt Godel in 1931. The papers also discuss various avenues for the misuse of science, both consciously, and unconsciously, (It is also highly possible and probable that European researchers simply did not understand issues from a cross-cultural perspectives, and various downstream and context-specific implications of their work) with data and evidence culled from various disciplines, and contexts, and suggests various methods to curb, and mitigate unwanted tendencies, in keeping with the ideals accumulated in our previous papers. Our paper also discusses and revisits other concepts such as the idea of “fuzzy logic”, (fuzzy is a common English term which also means hazy, blurry, non-focused, or ill-defined) which were originally developed in the context of computer sciences, as can be applied to the social sciences, besides the theory of paradoxes (as originally proposed by Bertrand Russell in 1901, and others; this can also extended to the evaluation of paradigms in the Sociological sciences), and neo-centrism, a philosophy that was developed by us in an earlier paper. This paper also discusses the tenets and characteristics of what we call ‘cross-cultural research design’, and its uses in science, chiefly in social science.

All these ideas and ideals, we fervently hope will serve the cause of science well, by leading to better quality of scientific endeavour developed with data and evidence collected from diverse social and cultural contexts all over the world, and serve the causes of society as well by promoting reliabilism; we strongly believe that a formal study of science in relation to the needs and wants of diverse societies has often been lacking, and this forms the philosophical foundation of much of our work, along with the general observation that much of scientific research, even in the social sciences, is a highly elitist enterprise, and is somewhat indifferent to the needs of society, particularly to the needs of non-western societies, and marginal societies. This has often led to self-reinforcing cognitive

dissonance, and has served to reinforce pre-scientific beliefs through a loop.

To remediate this, researchers, scientists and scholars from all over the world must participate in scientific enterprise, but an essential pre-requisite is that they must possess a scientific aptitude and temperament (as well as a faith in their own ideals), and must pursue rigorous and unbiased scholarship at all times. Thus, we do acknowledge the fact that a scientific temper is less widely prevalent across most Asian and African cultures than European cultures, even though this may appear to be a generalization. This must change over a period of time, hopefully through more widespread education, and better pedagogical techniques. (Until then, western scholarship must remain a strong counter-balancing force) However, cross-cultural research is imperative in the long-term since there would be difference between emic and etic perspectives, and cultural factors largely shape science; a person does not normally write about himself in the same manner as others would write about him.

While scope for original research in physics, mathematics, or chemistry is indeed limited, and cannot have the potential to absorb or attract more than a handful of scientists at any given point in time, social scientists in particular must look for ways to promote a scientific temper by creating what we called “Eureka points”, and “Mini Eureka points” among the laity: the rewards will transcend culture-driven scientific endeavour, and greatly boost economic output and enhance social progress in general across societies and cultures through a transformation of mind-orientation or cultural-orientation. Collaboration among scientists across cultures must also be based on mutual co-operation and mutual respect, bonhomie and camaraderie, rather than dominance or co-optation. Thus, we believe, the certainty uncertainty approach is one other way (in addition to the Sociological ninety ten rule), that better hypotheses can be formulated, and science be made a truly culture-neutral endeavour and enterprise.

Approaches such as these should also have other positive consequences and negate such unhealthy tendencies such as the tendency of scholars to confound their audiences through bombastic usage, or a clever jugglery of words, and lead to a better ground-up dissemination and percolation of science in diverse contexts and situations. This would also subvert situations where theories are supplanted by counter-theories, due to careerism or limited perspectives, and progress is elusive: scientific endeavour is often a carousel or a merry-go round characterized by an absence of a sense of direction, and this often continues ad infinitum. Our approach would induce a ripple effect or a domino effect, and lead to a higher scientific output not only through better hypothesis formulation but also by triggering suitable changes in mindspace, thought worlds, worldviews, mind-orientation and cultural-orientations. Such changes can also be modeled, though preferably not mathematically, and through the use of apposite social science research techniques. This must also be accompanied by suitable changes to the education system, as discussed by us in detail in our previous papers on the sociology of science,

anthropological pedagogy, twenty-first century historiography, and socio-cultural change; it would be superfluous and redundant to reiterate the postulates of these papers here. These deserve a careful read, and would as such, throw more light on the philosophy behind this paper. All these approaches would also additionally lead to what we call “Scientific progress at the speed of light” in different parts of the world.^{1 2 3 4 5 6 7 8} Uncertainty, incompleteness and undefinability in Physics and Mathematics.

In the field of physics and quantum mechanics in particular, the uncertainty principle, which is also often

¹ Unveiling the Sociological Ninety-ten rules for Social Sciences research: Towards better hypothesis formulation in the Social Sciences in the interests of higher quality research and intellectual multi-polarity Sujay Rao Mandavilli Published in IJISRT, February 2023

² Social Responsibility over Academic freedom: Emphasizing Ethics and Codes of Conduct geared for a Scholar’s duties towards science, society and the education system in Twenty-First Century Science Sujay Rao Mandavilli IJISRT September 2022

³ Unleashing the potential of the ‘Sociology of Science’: Capitalizing on the power of science to usher in social, cultural and intellectual revolutions across the world, and lay the foundations of twenty-first century pedagogy, Sujay Rao Mandavilli, Elk Asia Pacific Journal of Social Science, October – December 2020

⁴ Articulating comprehensive frameworks on socio-cultural change: Perceptions of social and cultural change in contemporary Twenty-first century Anthropology from a ‘Neo-centrist’ perspective Published in ELK Asia Pacific Journal of Social Sciences Volume 3, Number 4 (July 2017 – September 2017) Sujay Rao Mandavilli

⁵ The relevance of Culture and Personality Studies, National Character Studies, Cultural Determinism and Cultural Diffusion in Twenty-first Century Anthropology: As assessment of their compatibility with Symbiotic models of Socio-cultural change ELK Asia Pacific Journal of Social Science Volume 4, Issue 2, 2018 Sujay Rao Mandavilli

⁶ Introducing Anthropological Pedagogy as a Core Component of Twenty-first Century Anthropology: The Role of Anthropological Pedagogy in the fulfilment of Anthropological and Sociological objectives Sujay Rao Mandavilli International Journal of Innovative Science and Research Technology (IJISRT) Volume 3, Issue 7, 2018 (Summary published in Indian Education and Research Journal Volume 4 No 7, 2008

⁷ Introducing Anthropological Historiography as an integral component of Twenty-first Century Historiography: The role played by Anthropological Historiography in the attainment of long-term Anthropological goals and objectives International Journal of Innovative Science and Research Technology, February 2018, Volume 3, Issue 2 Sujay Rao Mandavilli

⁸ Historiography by Objectives: A new approach for the study of history within the framework of the proposed Twenty-First Century School of Historiography Sujay Rao Mandavilli

known as Heisenberg's uncertainty principle, and is named after its chief proponent Werner Heisenberg, (who first published this hypothesis in 1927 in a paper written in German when he was trying to build a model in quantum physics; this was chiefly formulated at the Niels Bohr institute in Copenhagen, Denmark) states that there is a limit to the accuracy with which the values of pairs of physical quantities of a particle (known as complementary variables, and canonically conjugate variables), such as position, and momentum, can be predicted. This principle states that both the position and the momentum of a particle cannot be known with certainty, and there will always be some uncertainty in their measurement. Thus, if the momentum of a particle can be predicted with certainty, the position of the particle cannot be calculated or measured with certainty, and vice versa. Even though this principle is largely negligible in the macroscopic world, or the real-world, (examples being the momentum and position of a moving car, a moving football or a crawling centipede or snail) where uncertainty in the position and velocity of objects (with large masses) is usually negligible, it is of great significance in Quantum physics given that atoms and subatomic particles have extremely small masses. In such a case, an increase in the accuracy of their positions leads to an uncertainty associated with their velocities.

This is now regarded as an important theory in physics, and one of the building blocks of quantum mechanics. This principle was followed up in the works of Robertson, de Broglie, Schrodinger and other researchers, but was criticized by Albert Einstein, Karl Popper and others. Another related concept is that of a Heisenberg limit. In quantum metrology, the Heisenberg limit is the optimal rate at which the accuracy of a measurement can scale with the energy used in making the measurement. This hypothesis is sometimes confused with the Observer effect which states that an object cannot be measured without in some way affecting it.⁹

Another important theorem is that of Godel's incompleteness theorem which was first published by Kurt Godel in 1931. This theorem comprises two separate theorems regarding the limits of provability, The incompleteness theorem states that, in any formal systems there will always be other true statements that still cannot be proved. This put paid to the theory or the notion that mathematics was a complete science, and could have solid foundations, without any contradictions, or limitations, and that there could be a mathematical theory of everything. Thus, this theorem made mathematicians of the time, jittery, as they hitherto unequivocally believed that mathematics was invincible. The downstream implications of Godel's work were huge, and his theory was subsequently modified by Ernest Nagel, James Newman, Barkley Rosser and others.^{10 11}

⁹ Sen, D. (2014). "The Uncertainty relations in quantum mechanics". *Current Science*. 107 (2): 203–218.

¹⁰ Smoryński, C., 1977, "The incompleteness theorems," in *Handbook of Mathematical Logic*, J. Barwise (ed.), Amsterdam: North-Holland, pp. 821–866

Another important concept is that of the Tarski's undefinability theorem, or the undefinability of truth. Tarski's undefinability theorem, as first stated and proved by the Polish-American mathematician and logician Alfred Tarski in the year 1933, is an important result in mathematical logic, and forms one of the basic foundations of mathematics. Simply put, this theorem states that arithmetical truth cannot be defined in arithmetic, or that the truth in a standard model of a system cannot be defined within the system or that there are aspects such as truth that cannot be encoded even in a sufficiently rich language. This concept though abstract, has some overlap with the concept of exceptionism and uncertainty as introduced in our papers.¹² Postulates of the Certainty uncertainty principle .

The following are the postulates of the Certainty-uncertainty principle that we propose in our paper in brief. The concepts delineated here are also related to the principles of our paper on the "Sociological Ninety Ten rule" which states that phenomena in the social sciences are not absolute, and exceptions across time or space can always be found. However, our paper now takes this much further as follows. This paper is the second on social science research method or research method for the social sciences, and it is hoped that these approaches will lead to a quantum enlargement of research in the social sciences, and will lead to a better quality of research too, besides eventually having a cascading effect on various fields in the non-social sciences, too. Our concept is quite dissimilar to the uncertainty, undefinability, and incompleteness theorems in physics, and these are only recapitulated to accomplish an interesting introduction, and draw similarities to the extent possible.¹³:

- This approach postulates a conscious and a continuous search for uncertainties in hypotheses or statements in the social sciences, or other sciences.
- Search for uncertainties in hypotheses or statements much become a mindset among researchers and scientists just as a search for exceptions (or exceptionism) is inculcated as a mindset.
- Certainties must be evaluated against uncertainties in every hypothesis or statement, and the net effect taken into account. However, theories can also be deemed insufficient or inadequate if some uncertainties are found.
- This approach must be adopted in addition to, or in conjunction with the principle of exceptionism. (also known as the Sociological Ninety-ten rule) which enquires if exceptions exist over space or time. Thus

¹¹ Awodey, S. & A.W. Carus, 2003, "Carnap versus Gödel on Syntax and Tolerance," in *Logical Empiricism: Historical and Contemporary Perspectives*, P. Parrini et al. (eds.), Pittsburgh: University of Pittsburgh Press, pp. 57–64

¹² J. L. Bell, and M. Machover, 1977. *A Course in Mathematical Logic*. North-Holland

¹³ Unveiling the Sociological Ninety-ten rules for Social Sciences research: Towards better hypothesis formulation in the Social Sciences in the interests of higher quality research and intellectual multi-polarity Sujay Rao Mandavilli Published in IJISRT, February 2023

cultural (synchronic) and time-based (diachronic) exceptions must be built into models, along with a deep inquiry into the underlying principles of any work, which includes various statements or hypotheses.

- Thus, data considered or used in the formulation of any theory or hypothesis can be inadequate in many cases, may lack comprehensiveness, or may not take all contexts or situations into account. In many cases, it may also be statistically inadequate, and may not absorb all kinds of values.
- This approach must be adopted in addition to Occam's razor, attributed to William of Ockham, which is based on the principle of parsimony, and which also states, in addition to its other postulates, that every theory or hypothesis must have as few assumptions as possible.
- This approach must be adopted in addition to a review of scientific methodology adopted, which forms the current gold standard and the cornerstone for the review of every theory, statement or hypothesis, whether rigorously applied or not, or whether accompanied or unaccompanied by bias or prejudice in any form.
- This method can be adopted in combination with dialectical approaches or intellectual dialectics (this is commonly understood as being a reconciliation of opposites, and was developed among others by Hegel, and in a more limited form by Karl Marx) and other approaches, even though our approach is *prima facie* different from a dialectical approach.
- This approach must also be adopted in addition to other factors such as paradoxes in a statement or hypothesis, its internal inconsistencies or logical non-sequiturs. It may also be evaluated against what we called "neo-centrism" or reflective equilibrium, first postulated by Henry Nelson Goodman, John Rawls, and others. Thus, paradoxes must be actively sought out in a paradigm. If there are a large number of paradoxes in a paradigm, the paradigm may be flawed, and not worth pursuing.
- Uncertainty can include both data uncertainty and method uncertainty; in the former case, data is non-comprehensive (is not statistically or logically complete, as opposed to its not being accurate, being flawed or misrepresented) or is non-reliable due to the aforesaid reasons. In the latter case, the methods adopted are unreliable.
- This approach must be accompanied by an analysis of "fuzzy logic" as explained in this paper. (The concept of "fuzzy logic" first arose in the context of computer sciences, and in our perspective, can and must be applied to the social sciences as well). Thus, research and downstream deductions, inferences and conclusions must be accompanied by as little fuzzy logic as possible. Fuzzy logic is usually much more subtle and difficult to detect than non-logic, but has an impact on scientific work nonetheless. It must be detected using specialized techniques, and usually social science research techniques, which can be carried forward to other fields of scientific activity, too.
- Wherever fuzzy logic does indeed exist, it must be identified, and if possible, quantified. Fuzzy logic must be differentiated from non-logic which has also been observed in the sciences, often in the acceptance or rejection of research, or the acceptance and refutation of

hypothesis. The latter is more extreme and is often ascribed to some "scientific ideology" such as Eurocentrism, or Indocentrism.

- This approach also calls for a review of uncertainties, and reviews possible means to address them. It also states under what circumstances uncertainties must be lived with. It may, at times present a roadmap to transcend them in the long-term.
- Evidence for and against a hypothesis can also be identified, and the two weighed in relation to each other. This is one of the building blocks of our approach.
- This approach also classifies evidence into weak evidence and strong evidence. Weak evidence and strong evidence can be used for or against a hypothesis. Some guidelines for what constitutes a weak hypothesis and what constitutes a strong hypothesis can be proposed; however, researchers must work these out for different contexts; in many cases evidence can be ranked on the basis of strength; hypotheses can also be ranked on the basis of inherent strength or weakness. Strong evidence is usually unearthed using better inter-disciplinary methods, though this is no hard and fast rule.
- This approach can give more power and credibility to scientific method (This paper also presents various examples from different fields and branches of science to show why this approach indeed has its merits).
- This approach can also be combined with an inquiry into the researchers cultural and ideological background for better effect, though this can by no means impinge on the results. Thus, "scientific ideology", whether racism, anti-racism, or any form of "centrism" must be identified and accounted for.
- This approach can easily be used to help detect scientific bias, and cultural bias in science when combined with other approaches.
- This approach, in combination with other approaches, can detect issues which other approaches cannot detect by themselves.
- Our principle states that if evidence against a hypothesis would override evidence for a hypothesis, it would automatically and naturally render it either limited, flawed, or unworkable.
- This approach can be used in a wide variety of contexts and situations in the social sciences, and can be extended to other sciences, too.
- This approach is based on the premise that many studies in the social sciences do not involve assumptions; however, they are based on observations, which may in turn, be tied to uncertainties. Assumptions are neither explicitly defined nor implicit for most theories in the social sciences.
- Assumptions must also be subject to the certainty uncertainty test in the manner that we have proposed; assumptions must be realistic, and must not defeat the purpose of a statement, or a hypothesis.
- This approach is also likely to go one step further than a common criticism of theories or paradigms, as it purports to be structured and comprehensive.
- It can also be used to segregate the probable underlying causes of stated phenomena from less likely ones.

- This approach does not include specialized categories such as scientific fraud which has been discussed by us separately; fraud or malfeasance would usually render some of, or all the body of work performed, invalid.
- Conclusions reached or a theory, hypothesis, or a body of work, must also not conflict with well-known laws and principles.
- Both the certainty uncertainty principle and the principle of fuzzy logic can manifest themselves due to what we may call cultural conditions; and misinterpretations arising from cultural differences.
- Uncertain factors or conditions must be stated as a part of the hypothesis usually as limitations, just as assumptions are stated as a part of the hypothesis, and we proposed that this should be one of the qualities and characteristics or good science. If the hypothesis works only in a limited context, or is subject to a set of conditions, the same must be stated upfront.
- This approach can be driven through a self-analysis or a self-investigation or a third-party (say, reviewer) analysis or a third-party (say, reviewer) investigation.
- From our perspective, a study of uncertainties must include uncertainties pertaining to all allied fields of study as impacting the research, and a truly inter-disciplinary approach must be adopted.
- A commitment to the cause of science must always be the primary guiding principle, and must override inconvenient truths; however, in case there is an uncertainty, and the absolute truth cannot be pursued, the cause of society, and the potential for the misuse of scientific paradigms must be considered. Thus, misuse of the certainty or potential certainty must be mitigated. Thus, the potential misuse of uncertainty, which is not in the interests of science must be considered. If we state, that blacks perform poorly in IQ tests compared to Asians or whites, all the uncertain factors contributing to the difference must be identified and isolated.
- This approach in combination with the Sociological ninety ten rules and other rules, will lead to better scientific output, and a faster progress in the social sciences and the other sciences, and impart science with a sense of direction by minimizing, or rendering obsolete, meaningless digressions into unwanted directions. This has often, unfortunately happened, and we have been presenting multiple examples throughout the years. This is the *raison d'être*, and the fundamental philosophy and premise behind our work.

II. FUZZY LOGIC

Logic, which in popular parlance refers to a certain way of thinking, (the term is derived from the Greek word "logos") is defined in science as the study of the principles of correct reasoning, and its distinction with the principles of incorrect reasoning. The ability to pursue logical reasoning is considered to be an attribute central to humans, and this characteristic sets humans apart from other animals. Logic and reasoning are tied to propositions which are defined as claims, statements or assertions. Logic also includes in its purview, both formal and informal logic. Formal logic may be defined as the science of deducing

valid inferences or of arriving at logical truths, based on data or premises, and subject to certain methodologies, popularly known as scientific methodology. It is a science that investigates how conclusions follow from premises in a logical and a neutral way. Logic also studies arguments, which comprise a set of premises or propositions along with a conclusion reached. Arguments may either be correct or incorrect; in some cases, they may not be complete, or may be flawed in some way. Logic is also often used to derive proofs, or refute claims. Informal logic, is applied to less formal contexts, but nonetheless uses similar principles of critical thinking and analysis. Logic is central to many fields of science such as computer sciences, and mathematics, (where it can be usually studied with a great deal of rigour and objectivity: for example, in Mathematics, if $p > 1$ and $q > 1$, then $p+q > 1$ always) though it is more elusive in the social sciences, and may be hard to pursue with the same rigour and objectivity as the social sciences, given that social sciences are often dependant with more abstract ideas such as culture and human behaviour. Logic is also tied to many formal methods of analysis such as dialectical approaches and argumentative theory. In general, good logic leads to healthy scientific outcomes, and helps distinguish the good science from the bad.¹⁴

Another interesting concept is that of fuzzy logic. In computer science, fuzzy logic is an approach in variable processing that permits many possible truth values to be processed through the same variable. In this case, the truth value of variables may be represented by any real number between 0 and 1, and the truth value may range between completely true and completely false, and can thus represent partial truth or partial mistruth. This is in contrast to Boolean logic or classical logic where the truth value of variables can only be either 0 or 1, or yes and no. This concept is usually attributed to the pioneering work of Iranian-Azerbaijani mathematician Lotfi Zadeh who first presented his work in the year 1965, even though it can be traced back to the earlier work of Lukasiewicz and Tarski in the 1920's. Fuzzy logic is also closely tied to the observation that people usually make decisions based on imprecise or non-numerical information, usually accompanied by biases and prejudices. Hence, this concept overlaps with the concept of certainty uncertainty as espoused in this paper, even though the two may be somewhat distinct and different.

On the other hand, in Mathematics, Fuzzy models or sets are means of representing vagueness and imprecise information (this is represented by the term fuzzy). Such models are designed to recognize, represent, manipulate, interpret, and use data and information that is vague or lack certainty. This concept has found useful application in many fields of study such as artificial intelligence (analogy with neural networks) and control theory, (and is also found in daily life: for example, people cannot express complex colours, or quantify emotions. In most cases, knowledge is

¹⁴ Haack, Susan (1978). "1. 'Philosophy of logics'". *Philosophy of Logics*. London and New York: Cambridge University Press. pp. 1–10. ISBN 978-0-521-29329-7

also culturally constructed, and is tied to the process of identity formation, acculturation, or enculturation. In other cases, decisions are based on partial or incomplete knowledge). This concept is also different from non-logic or absence of logic; It is also different from untestable statements or statements of opinion such as the ethics of meat-consumption. Non-logic or absence of logic characterizes an endeavour or activity as non-science; (This is also related to dubious logic: for example, we should not eat in Burger King because its workers are poorly paid: this logic or reasoning may be irrelevant for most logical analyses) however, the concept of fuzzy logic, we believe, is integral to the social sciences. The concept of fuzzy logic is also somewhat different from leaps of logic, or logical non-sequiturs, which represent flaws in scientific method. The concept of fuzzy logic would also be naturally somewhat different in the social sciences than it is in the mathematical sciences, and the two are somewhat in variance with each other.^{15 16}

The concept of fuzzy logic may also be represented or explained by degrees of truth in the mathematical sciences. In order to represent fuzzy logic mathematically, non-numeric variables (i.e. adjectives) such as “big”, “small”, “young” and “old” are commonly used, along with additional qualifying or describing words such as “rather” and “somewhat”, or sometimes through the use of complete statements such as the very interesting statement, “if the train is going “fast”, or is “near” a “big” station, “reduce” the speed”. These may often be mapped to ranges of values. In fuzzy logic, “fuzzification” is the process of assigning the numerical input of a system to fuzzy sets with a certain degree of membership (belonging). Values may also be represented in a continuum between zero and one. Zero means the value does not belong to the fuzzy set, while one means the value completely belongs to the fuzzy set.

The concept of fuzzy logic is also different from probability, though it is somewhat related to it. It is also related to the concept of quantification, which is related to the measurement of imprecise variables, or the quantification of the unquantifiable. Having said all this, we also strongly believe that this concept must find its rightful place in the social sciences as well, and must be deeply embedded, entrenched and ingrained in social science theory, and relevant concepts carried over or rolled forward from other fields or branches of science as necessary. The structured usage of fuzzy logic in the social sciences would be somewhat different from the current random, arbitrary, inconsistent and ad hoc application of fuzzy logic to the social sciences.

The following are the additional characteristics of “fuzzy logic”, in addition to those we had proposed above, and in a previous section:

¹⁵ Novák, V.; Perfilieva, I.; Močkoř, J. (1999). *Mathematical principles of fuzzy logic*. Dordrecht: Kluwer Academic. ISBN 978-0-7923-8595-0.

¹⁶ Zadeh, L. A. (June 1965). "Fuzzy sets". *Information and Control*. San Diego. 8 (3): 338–353. doi:10.1016/S0019-9958(65)90241-X. ISSN 0019-9958

- To summarize, fuzzy logic is very subtle, and is usually very difficult to detect. It is usually much more subtle to detect than non-logic (leaps of logic or logical non-sequiturs), but has an impact on scientific work nonetheless.
- Fuzzy logic may impact scientific work directly or indirectly; the former would be characterized by inadequate scientific method, while the latter could be caused by secondary factors such as ideology.
- There could be an overlap to varying degrees between fuzzy logic and the certainty and certainty principle, and the two could be used in tandem wherever necessary.
- There could be multiple causes of fuzzy logic. Examples of causes of fuzzy logic are (a) inability or the scholar or researcher to delve into details, or carry out painstaking research (b) non-optimal scientific method (c) Unconscious bias (c) cultural bias (d) absence of complete data, knowledge or information (e) lack of knowledge of cultural conditions, or the nuances and intricacies of a culture (f) Inability to process information, or extract knowledge. Thus, fuzzy logic may either be conscious, or unconscious.
- Fuzzy logic can be hard to detect, and can usually be detected only through the adoption of a large number of checks and balances.
- It must be detected using specialized techniques, and usually social science research techniques, which can be carried forward to other fields of scientific activity, too.
- Techniques can include a wide variety of social science research techniques such as ethnography, annotated ethnography or cross-cultural ethnography.
- Techniques can also include investigative techniques and drill-down techniques which can be carried out to the extent precision, clarity, or detail is required. This can expose shallow or ill-conceived research.
- The fact that we recommend the use of social science research techniques (either existing, or yet to be formulated), makes this approach different from other forms of evaluation of logic or non-logic. It is naturally much deeper form of inquiry, and also much more intense, and includes in its purview, factors such as researcher psyche, cultural background, ideological background, and wherever possible, a study of his or her inner urges and motivations as well.
- Researchers both in the social sciences and the non-social science are prone to errors of fuzzy logic, though it manifests itself in more complex ways in social sciences research.
- The use of fuzzy logic is also common in daily life, besides scientific activity. We have provided some examples for this in our paper.
- The term fuzzy logic is used because fuzzy logic does indeed entail the use of some amount of logic; however, it may be inadequate or insufficient. In a handful of cases, it could be perverted, or caused by bias and prejudice.
- Wherever logic applied is insufficient or inadequate, due to any form of a constraint, such as absence of evidence, or a time constraint or a constraint, it should preferably be stated so by the author, or highlighted by the reviewer.
- Fuzzy logic can also manifest itself in acceptance, non-acceptance of hypotheses or complex new ideas, or the

review of scientific work (rarely is a holistic evaluation, ideology-free or a bias-free evaluation done). It can also manifest itself in aspects such as communication of science, and indeed, all facets of scientific activity. In extreme case, wrong ideas, or flawed paradigms may get widespread acceptance, and correct ideas brushed under the carpet, or relegated to the background.

- In some cases, fuzzy logic or faulty logic may be hard to detect, examples being those pertaining to the flat earth hypothesis, the geocentric theory, and early attempts to measure the size of the earth.
- Our hypothesis is: Almost all activities involving the human psyche, human involvement, and human interactions, involve some form of a fuzzy logic. Exceptions to this rule may indeed be very rare, and can be determined using the sociological ninety-ten rules.
- Thus, absolute logic or classical logic may rarely be applied in the social sciences; logic in the social sciences IS fuzzy logic.
- Fuzzy logic may be effective, even if not morally or ethically correct. For example, dictators have, throughout history sought to rouse their masses, and goad them towards war through dubious techniques, and have unfortunately succeeded in many cases.
- Measuring fuzzy logic in all facets of scientific activity is not a distant pipe dream; it can indeed be accomplished, and we will be looking forward to more work by other researchers in the field.
- Identification of fuzzy logic must be built into scientific methods, particularly in the social sciences, and must be actively sought out either through self-analysis, or third party review. We believe our approaches are sufficiently different from existing approaches in the social sciences, or any other sciences.

Examples of fuzzy logic (or faulty logic) could include statements such as the following (These must be distinguished from non-logic as some logic has indeed been applied in these contexts)

- The earth is still and motionless because it appears to be still or motionless
- The earth is flat because it appears to be flat
- The geocentric theory is correct because the sun appears to move around the earth

The following statements also appear to be logical, but are not complete, are not based on a thorough analysis, or do not satisfy the principle of exceptionism (or an analysis of contradictory data, rules, or rule sets); they may also be logically fallacious. To the trained scholar or even to the layman, they may appear to be vague, even though they may be used as inputs into other research. These are not necessarily culled from research contexts. (These however demonstrate inadequacies or fallacies in logic and reasoning, and would be closer to social sciences research than other forms of research: these have been carefully chosen for this specific reason) These should serve to illustrate the concept of logic, non-logic, and fuzzy logic better:

- The decline of cinema in recent years is due to rise of internet (This statement is not fully tested, or is not based on complete evidence).

- Globalization has led to a decline in Indian languages (This statement is not fully tested, or is not based on complete evidence. All dimensions of the issue are not also understood. Thus, this statement has not yet been proven to be a fact, or a non-fact).
- When infrastructure in Indian cities cannot be improved, build expressways, this will give a better impression to foreigners (Because foreigners impressions of India are not based on a balanced analysis, or a thorough examination of all evidence. In addition, the term “foreigner” is not a homogenous entity).
- Foreigners assume that all Indians are poor because it has a low per capita income (This is an over simplification, and is not based on an examination of all data or evidence).
- Good A is superior because it is expensive (This is a logical fallacy).
- Good A is superior because it is imported (This is a logical fallacy).
- Good B is inferior because it is cheap (This is a logical fallacy).
- Foreigners show the dark side of India because they are racist (This may not always be the case; they may show the dark side of India because they want to generate awareness, or because they find it different from the more opulent West).
- People say that only Chandrababu Naidu (The ex Chief Minister of Andhra Pradesh, a state in India) developed the city of Hyderabad even though other chief ministers also contributed to its development. They say so because this is a popular over-simplification, and because an evaluation in this context can be rarely comprehensive.
- People say they don't like India because everybody else said they don't like it.
- Vintage cars can't go faster than modern cars – this is an example of fuzzy logic because the performance of cars is dependent on many factors. This statement is based on an incomplete understanding, logic or analysis, though in general (a vague term), modern cars are faster than vintage cars.
- Americans do not like Indian food because it is too spicy- this is an oversimplification (broadly true, but there can be many exceptions, and this issue needs to be studied more in depth).
- Indians do not like pasta and they do not like cheese – this is an oversimplification, but there can be many exceptions, and this issue needs to be studied more in depth).
- Chandrababu Naidu (the ex Chief Minister of the Indian state of Andhra Pradesh) developed Andhra Pradesh into a model state because he developed Hyderabad: This assertion does not take into consideration all aspects of development, or define measures or benchmarks of development.
- The Taliban was beneficial for Afghan society because it destroyed poppy seeds. (This is based on bias or limited understanding. A devout Muslim may see the beneficial side of the Taliban, while a Hindu may criticize it more severely) This may also impact the quality and direction of subsequent research).

- A popular article by an award-winning researcher was picked up downstream by other researchers who mimicked its style and content, without questioning. Subsequent research took off tangentially, and it took years before course-corrections were finally made.
 - I say something because everyone else says it: this is a form of fuzzy logic.
 - People who have accomplished many things automatically become famous: This statement is a form of fuzzy logic because there could be many exceptions to this rule.
 - People who don't deserve to become famous don't become famous: This is a form of fuzzy logic because there could be many exceptions to this rule.
 - Support for a political party is often based on fuzzy logic, since no political party is completely perfect, or completely imperfect, and a comprehensive analysis usually proves elusive.
 - Criticism of a political party is often based on fuzzy logic, since no political party is completely perfect, or completely imperfect, and a comprehensive analysis usually proves elusive.
 - The global hunger index is a form of fuzzy logic since it may not be based on complete data, may be researchers' personal bias or prejudice, confirmation bias, or desire to pander to specific audiences.
 - The most developed countries of the world index is a form of fuzzy logic since it may not be based on complete data, may be based on researchers personal bias or prejudice, confirmation bias, or desire to pander to specific audiences.
 - India is economically not successful, so Indian culture must be inferior. This is a logical non-sequitor. In addition, the terms inferior and superior cannot be adequately defined.
 - Indian civilization is old, so Indian culture must be superior. This is a logical non-sequitor. In addition, the terms inferior and superior cannot be adequately defined.
 - I decide to support Nehruvian socialism or laissez free capitalism based on fuzzy logic, since I do not have complete data or knowledge on the subject. In addition, there is always some amount of judgment involved in the evaluation of economic models.
 - I support the Amaravati project (A smart city project in the state of Andhra Pradesh, India) because Chandrababu Naidu, the ex Chief Minister of Andhra Pradesh has a brand image.
 - The statement 'Delhi is a clean city' is a form of fuzzy logic because Delhi has many types of neighbourhoods (and "dirty" and "clean" are difficult to define precisely). This statement is more or less based on judgment or experience.
 - The statement "Delhi is a dirty city' is a form of fuzzy logic because Delhi has many types of neighbourhoods (and "dirty" and "clean" are difficult to define precisely). This statement is more or less based on judgment or experience.
 - I say Kolkata is dirty (even if I actually felt otherwise) because everyone else says so.
 - The statement Paul is a bad man is a form of fuzzy logic because the term 'bad' is subjective and because human characters are usually complex.
 - The statement the Austin A40 is a very good car and I like it very much is a form of fuzzy logic because both the assertions "a very good car" and "I like it very much" are highly subjective.
 - The statement "Bose got India its freedom, and not Gandhi", is an oversimplification because many different individual fought for India's freedom; this statement is also tied to a political ideology.
 - The statement that trickle down economics always works is a form of fuzzy logic, since it is not based on a complete analysis or an analysis of all situations.
 - People make decisions without a complete and a balanced analysis: this is a form of fuzzy logic, since balance cannot be defined or quantified precisely.
 - People take sides in a debate without a proper evaluation: this is a form of fuzzy logic, since it is indeed difficult to grasp or comprehend all aspects of a debate, and analyze them in relation to one another.
 - People believe exaggerated claims: this is a form of fuzzy logic, since it is difficult to test all claims fully or comprehensively.
 - Loaded logic is also a form of fuzzy logic. For example: "I dislike India, so I avoid eating Indian food."
- The following logic also constitutes fuzzy logic, and may additionally impact research work and scholarship, and have a bearing on the direction of science, and the quality of scientific output, since they are tied to scientific ideology:
- Hindutva forces claim that their constructs of history must be supported because Marxist historiography is one-sided. Others believe this to be true and support their constructs, or follow them slavishly, because their logic is very appealing to those who follow an ideology, or those who possess a certain mindset.
 - Marxist historians claim that Marxist historiography must be supported because Hindutva forces have misrepresented history. This logic appeal to some people, and logical fallacies can be quantified and tied to ideology.
 - Marxism is outdated because it has suffered setbacks. This statement also fails to take into consideration a logical analysis of Marxism, or discounts the possibility of a resurgence of Marxism. Besides, the term "outdated" is not sufficiently defined.
 - Marxist historiography is outdated because Marxism has suffered setbacks: Therefore, we must abandon Marxist historiography, and throw the good out with the bad. This statement erroneously links Marxist historiography with Marxism, though the postulates of the two are fundamentally different.
 - The statement "I was disgusted with Dravidian nationalism, so I accepted the Hindutva ideology" is an example of fuzzy logic, since the person here appears to be jumping the gun. There could be many alternative philosophies in addition to these two belief systems.
 - The statement "I was disgusted with Eurocentrism in Indology, so I implicitly believed in Hindutva" is an example of fuzzy logic. There any many other ideologies

in addition to these two, and this is therefore, a logical non-sequitor.

- I read about the caste system so I became anti-Hindu is an example of fuzzy logic, since the religion that we now call Hinduism comprises many different belief systems. This belief therefore impacts my research on Hinduism. This statement is based on insufficient evidence or knowledge.
- I have personal scores to settle with an author. Therefore, I review his work less objectively. This constitutes a form of fuzzy logic, though not in the absolute sense of the term.
- Fuzzy logic may also manifest itself in the acceptance or rejection of new ideas, where pure and unadulterated logic does not always come into play; new ideas may be initially rejected even they are correct, and false ideas may gain currency. One way to prevent this from happening is to pursue higher quality science, and to allow for better education through better pedagogical techniques. For example, Aristarchus of Samos and Philolaus' heliocentric theories were not taken seriously for centuries. Even the work of Copernicus, Tycho Brahe's work, and Johannes Kepler's work took some time to gain traction. Giordano Bruno was burnt at the stake for heresy and Galileo faced an inquisition and faced house arrest. Copernicus escaped the wrath of the church only because he was in far away Poland. Gregor Mendel's pioneering and ground-breaking work was ignored during his life time; while Einstein was luckier, Robert H. Goddard's theories on rocketry were initially ridiculed. Likewise, Srinivasa Ramanujam would have headed down the road to obscurity had he not found a saviour in GH Hardy. There are also two ways a new idea can gain traction. One is represented by the inside out phenomenon, and the other is the outside in phenomenon. In case of the former, changes are first accepted by the mainstream scientific community, and then spread outwards to the common public. (This is the most common way new ideas are accepted as specialists are in a better position to appreciate new ideas than the layman, or because laymen may implicitly believe in specialists, either correctly or incorrectly) In case of the outside in approach, the common man is aware of, or appreciates a new idea more quickly, while there is a continued resistance from the mainstream scientific community; this phenomenon commonly occurs when the scientific community is highly degraded in a particular respect, or has become dogmatic. An interesting example of can is the case nineteenth century Indological scholars, who proved to be impervious to change, and blind to reality in the Twenty-first century, as they did not embrace changes for decades; thus, their discipline and their practice effectively collapsed. The general observation throughout time is that inventions get accepted relatively more rapidly while abstract ideas get accepted more slowly; acceptance in the social sciences are typically much slower; this is only an observation, and there could be many exceptions to this rule. In another realm, dimension and plane, the automobile was widely accepted in the early twentieth century, and most users of this technology were oblivious of the ill-effects of pollution, which were not understood until much later.

Here are some more interesting observations and characterizations about fuzzy logic:

- Application of Occam's razor involves a form of fuzzy logic given that different interpretations of Occam's razor can occur. Thus, even scientific method must be applied carefully and cautiously.
- Fuzzy logic and confused timeframes: mixing up of chain of events and use it for erroneous decision making is common, but is only one example of how flawed decision-making often is, in daily life. This is naturally a very common form of fuzzy logic, and may have occurred because data or evidence was not systematically recorded.
- People take two steps forward and one step backwards in a bid to control others, and the victim often believes them: this is a form of fuzzy logic, and one that is used to control and dominate others, by confounding them and confusing them. This is an interesting downstream activity of the concept of decision making.
- Cherry picking is a form of fuzzy logic, or is related to fuzzy logic, since some data is knowingly or sub-consciously not selected.
- Selective obfuscation is a form of fuzzy logic, or is related to fuzzy logic since some data is knowingly or unknowingly not taken into account.
- Over-generalization is a form of fuzzy logic, or is related to fuzzy logic, since all details are not sought.
- Over-simplification is a form of fuzzy logic, or is related to fuzzy logic, since all data is not considered.
- One-sided analysis leads to fuzzy logic, or is related to fuzzy logic. The motivations behind this could be many; in some cases, this may not be carried out fully consciously.
- Confirmation bias leads to fuzzy logic, or is related to fuzzy logic; since other data is conveniently ignores since one sees or hears what one likes to see or hear.
- Concepts such as cognitive dissonance must be studied together with fuzzy logic, since patterns of thought-building are not always logical or regular.
- Concepts such as self-reinforcing cognitive dissonance must be studied together with fuzzy logic, since patterns of thought-building are not always logical or regular.
- Concepts such as dogma must be studied together with fuzzy logic, since patterns of thought-building are not always logical or regular.
- Concepts such as cultural bias must be studied together with fuzzy logic, since patterns of thought-building are not always logical or regular.
- Manipulators, schemesters and schemesteresses use fuzzy logic to confound others; this is based on the premise that others do not always follow logical patterns of thought.
- Decisions made during an argument use fuzzy logic, and rarely is a complete analysis carried out at the heat of the moment, since there is no time to mentally process and analyze data.
- Decisions made under mental stress use fuzzy logic, and rarely is a complete analysis carried out, since conditions are not conducive to analyze and process data.

A. Characteristics of fuzzy logic

Thus, the following are the additional characteristics of fuzzy logic, and the characteristics of the decision making process using fuzzy logic:

- It (the application of fuzzy logic) always leads to an outcome.
- Sometimes more than one outcome is possible.
- Outcome or outcomes can be predicted with a certain degree of probability.
- Fuzzy logic is based on some kind of a decision-making process or logical premise. Thus, fuzzy logic may have a nugget of truth to it. Thus, is unlike absence of logic, where no formal decision making process is involved.
- The decision making process is usually not perfect, and the logical premise is usually not perfect. Thus, perfection in the decision making process, and the attainment of a perfect logical premise are rare in the social sciences.
- Sometimes, fuzzy logic is based on a patently false premise.
- Therefore, the different types of fuzzy logic are (a) fully false or untrue (b) mostly false or less likely to be true (c) somewhat false or somewhat true (d) less likely to be false, or most likely to be true (e) Not false (true) (Absolute values are however, less common in the social sciences)
- Fuzzy logic can also be classified on the basis of intention, cause or objective (a) Presence of made fide intention (b) absence of male fide intention (c) Ignorance of scientific method (d) Ignorance of data.

B. Measurement of fuzzy logic

Fuzzy logic can also be often measured, usually approximately, through the use of appropriate and apposite social science research techniques such as ethno methodology and ethnography (or less common techniques such as the study of human portraits or biographies). It is often measured by quantifying the impact of such logic on research output such as results, or on downstream research. It is often analyzed against the backdrop of the precision that can be realistically, practically or economically attained, and the precision that is not practical or economical to attain. Fuzzy logic can also usually be ascribed to various causes such as cultural bias, flawed methodology, or incompleteness or unreliability of data, through the process of root cause analysis. It is also often accompanied by remediation strategies, which seek to mitigate or minimize it further.

C. Uses of the certainty uncertainty principle and fuzzy logic

The twin concepts of certainty uncertainty and fuzzy logic, can therefore be an invaluable aid in research and decision making in the social sciences, when used in combination with other social science research techniques such as grounded research, inductive approaches, and data, method and investor triangulations. They can be used to evaluate research carried out by researchers of various cultural backgrounds, and research as applied to various cultural backgrounds, to sift the grain from the chaff, and weed our poor science, or restrictive science from good science or universal science. It can also propose techniques

that would lead to better quality and more reliable and consistent scientific output across situations. Its applications can spawn a plethora of new kinds of applications in the social sciences, in fields ranging from behavioural sciences to psychology, and social anthropology to behavioural economics. We can also use this to identify a researcher's scientific ideology, or a general non-scientific ideology or bent of mind as mapped against a researcher's cultural orientation, (and mind-orientation, thought worlds and world views mapped to a cultural taxonomy) and in turn use it to identify and quantify the impact of ideology, and personal biases and prejudices on scientific; this would be as cardinal a sin as pseudo-science even if not widely accepted and acknowledged as such. People's appreciation of science, their scientific temper, or the lack of it can also be understood; we can also understand whether they slavishly subscribe to an ideology or not.

More importantly, the certainty uncertainty principle can also be used to evaluate underlying causes behind effects, and rank them on the basis of certainty or probability. Thus, improbable causes can be identified and eliminated (the underlying mischief behind their identification may also be stated wherever applicable), and the more probable causes highlighted. This principle can be put to use in a large number of ways in commonly presented hypotheses in various fields of science, particularly the social sciences.

III. PARADOXES AND THEIR ASSESSMENT

A paradox is a statement or proposition (in a hypothesis or paradigm) with apparent logical contradictions in facts, characteristics or propositions. This may often make it difficult to grasp, comprehend or understand. A paradigm may also involve contradictory elements which may exist simultaneously, and may be inter-related to each other in varying degrees, and may be caused due to factors such as self-reference and circular definitions. These contradictions are often innate and inherent to the paradigm or hypothesis itself, and may therefore be persistent. This often leads to a lasting unity of opposites. Several statements or components of a statement or hypothesis may therefore be wholly or partly true, or completely untrue.¹⁷

There have been many paradoxes presented throughout history by logicians examples being the famous Russell's paradox, Zeno's paradox, Curry's paradox or the ship of Theseus, and these have served to lay the foundations of the concept of a paradox. According to Patrick Hughes, the three characteristics of a paradox are self-reference or a statement referring to itself, contradiction, and vicious circularity. According to Willard Van Orman Quine, paradoxes are of different types, including a veridical paradox which produces a result that is apparently absurd, but nonetheless true, a falsidical paradox which establishes a result that not only appears to be false, but is actually false

¹⁷ William Poundstone, 1989, Labyrinths of Reason: Paradox, Puzzles, and the Frailty of Knowledge, Anchor

and an antinomy which arrives at a self-contradictory result through proper reasoning. A statement that is both true and false at the same time is referred to as a dialetheia, and this is sometimes taken to be the fourth type of a paradox.

From our perspective, every statement, paradigm or a belief-set must be consciously and consistently examined for paradoxes. Paradoxes may be large in number, but mostly trivial. They may also be significant, but relatively small in number. They may also be significant and substantial at the same time. They may also be peripheral or mostly irrelevant to the hypothesis, or may be central and critical to the success of the hypothesis. They may also be internal, and may not reference any external statement, or they may be external, and must be understood only in relation to external phenomena. They may also be simple to detect and understand, and may not require special expertise, or they may be complex and may often require (inter-disciplinary) expertise. They may also render the hypothesis, statement, paradigm or philosophy fully or partly relevant or valid at times, or may defeat the purpose of the hypothesis, or belief set at other times.

All philosophies that claim to produce systematic thought must be examined for paradoxes, and schools of thought such as Marxist historiography or Hindutva approaches to history (or the work of any one particular scholar) may be declared limited, or at worst, unworkable if found riddled with paradoxes. This approach must be conscious, adopted by force of habit, must become a way of life or mindset, and must also be combined judiciously with the other concepts we have proposed in this paper, and with other more common and mundane techniques such as the review of assumptions, and the review of methodologies adopted. This must also be coupled with the rise of scholarly activity in different parts of the world as we acknowledge and fully understand that culture is often the backbone of scientific ideology, with a particular reference to social sciences. Other novel and innovative techniques can also be used, examples being a ‘closed loop model’ such as the one we had proposed to solve the ‘Aryan problem’; this was presented in the second part of a two part paper. Paradoxes must also be actively sought to be reduced in paradigms, statements or hypotheses, and superior technologies or better working methods can tackle paradoxes, examples being the recent and new-found thrust on sustainable development, on the slowly increasing interest on bottom-up development models across the world, particularly in developing countries, as well as better and better social security systems throughout the world.¹⁸

¹⁸ Frode Alfson Bjordal, *Librationist Closures of the Paradoxes*, Logic and Logical Philosophy, Vol. 21 No. 4 (2012), pp. 323–361

IV. USES OF THE CERTAINTY UNCERTAINTY PRINCIPLE FOR ROOT CAUSE ANALYSIS

In our view, research on such controversial topics, and the application of the certainty uncertainty principle for a root cause analysis would rest on several fundamental pillars (This approach will be used if the underlying cause or causes behind a phenomenon cannot be traced with certainty)

- The principle of overall good to science must reign supreme. This factor must override all factors under all circumstances, and the truth must be accepted even if it is a bitter pill to swallow. However, if uncertainties are still present, they must be stated upfront.
- This having been said, all factors must be rated on the basis of their certainty or uncertainty.
- Improbable or highly unlikely factors must be ruled out completely.
- There must be no personal bias or prejudice or any form of careerism, in the evaluation process. The impact of various ideologies, if any, must be neutralized.
- Robust scientific methodology must be adopted based on reliable and complete data. Anything less would be completely unacceptable.
- Experiments must always be designed from a cross-cultural perspective; for example the IQ of blacks raised by intellectual whites may be defined as a test; such tests should be designed to expose scientific biases, and eliminate all other biases as well. Large samples, accompanied by a structured sampling approach for diverse data must always be used. Underlying assumptions such as the design of IQ tests must be constantly visited and revisited too, and concerns of different cultural groups taken into consideration. Cross-cultural groups must always work in tandem, and designs of experiments must always be cross-examined, and exposed for cultural bias if any. We would like to call this cross-cultural research design, and this is necessary to neutralize ‘scientific ideology’. For example, the Vedic Indus hypothesis, the Dravidian Indus hypothesis, and the Paramunda Indus hypothesis were all developed on the basis of specific ideologies. None of these hypotheses have been proven to be either conclusive or certain. However, evidence for or against all these hypothesis can be categorized on the basis of strength as discussed by us in papers on Indology, and this also forms an important postulate of this paper. Therefore, evidence given by Witzel on the Paramunda hypothesis is weak, as readers can figure out, as is evidence provided by Farmer on the Indus non-script thesis.
- All exceptions must also be identified and taken into consideration, and we have constantly emphasized this principle.
- If there is a tie, the principle of misuse or blatant misuse must be taken into consideration; for example, if it is postulated that the low intellectual output of developing countries is tied to “racial” factors (This is a highly uncertain and risky assumption), all other factors must be ruled out first, and this would be an essential pre-requisite. This postulated conclusion, can have several unsavoury consequences, including negative social

consequences, and must not be accepted unless absolutely necessary, and unless all other factors are eliminated completely.

V. NEO-CENTRISM

We had also introduced the concept of ‘Neo-Centrism’ (or more simply expressed, Centrist) in an earlier paper, and had also elaborated on these subsequently; we additionally reiterate the core sections of this philosophy here. ‘Neo-Centrism’ is defined as a neutral and an ideology-free approach to all issues pertaining to various fields of study particularly in the social sciences, and must also be distinguished from a political ideology bearing the same name. It is an alternative and an “in-between approach” to the approaches espoused by the left and the right (or any other set of rival and extreme ideologies) in specific circumstances. It also has a long-term orientation and seeks out solutions that work across the dimensions of time and space. It is largely based on dialectics, a Continuous reconciliation of Contradictory data or evidence or CRCDE, and seeks a reconciliation of views across scholars and ideologies, and can be merged with concepts such as that of reflective equilibrium and Reflective equilibrium through role swapping or RERS. It can also be applied in tandem with all the other philosophies proposed as a part of this paper. For a more detailed explanation, readers may refer to our earlier papers.

Thus, we believe that the time has come in the post-internet and the post-globalized and the highly networked and interconnected world, for scholars and researchers to pursue rigorous and critical self-scrutiny and self-analysis to avoid third-party criticisms either due to cultural predilections or otherwise; scientists must strive to provide what we can call a “cultural frame of reference” for scientific paradigms taking into needs the unique needs of different cultures through a culture-sensitive approach, thus slowly and gradually edging out pre-scientific beliefs. Thus, scientific historiography may work in India the way Darwinism worked in the West. We have discussed these concepts threadbare in our paper on the ‘sociology of science’, and all scientific activity must be evaluated against this philosophy. Self-analysis and self-criticism is also often the best approach; if this cannot be done, a formal and a structured enterprise that critiques research, and evaluates it against social contexts must be put in place.^{19 20}

¹⁹ The relevance of Culture and Personality Studies, National Character Studies, Cultural Determinism and Cultural Diffusion in Twenty-first Century Anthropology: As assessment of their compatibility with Symbiotic models of Socio-cultural change ELK Asia Pacific Journal of Social Science Volume 4, Issue 2, 2018, Sujay Rao Mandavilli

²⁰ Articulating comprehensive frameworks on socio-cultural change: Perceptions of social and cultural change in contemporary Twenty-first century Anthropology from a ‘Neo-centrist’ perspective Published in ELK Asia Pacific Journal of Social Sciences Volume 3, Number 4 (July 2017 – September 2017) Sujay Rao Mandavilli

VI. REAL-WORLD APPLICATION AND REAL-WORLD EXAMPLES OF THE CERTAINTY UNCERTAINTY PRINCIPLE

We now present some very real-world applications and real-world examples of the certainty uncertainty principle and fuzzy logic, drawn from various fields of the social sciences and from the other sciences as well, with a particular emphasis on theories and experiments. These have been carefully selected from a diverse spectrum of ideas and should serve to back up our concepts very well, but readers will find a major thrust on the social sciences and other allied fields of science, which are also designed to demonstrate the overlap between the social sciences and other sciences. These should serve to reinforce our observations as well as help us to draw more conclusions regarding the concept of certainty uncertainty, and all its other allied concepts as well. They should also serve to show how rigorous scholarship has often eluded mainstream researchers. While research is indeed a complex affair, improvements can nonetheless be brought about, and digressions, or forays into dead-ends avoided through ideology-neutral science and critical self-analysis. This approach can be applied to more complex affairs too, such as the idea of God, reincarnation or even astrology, though this would be extremely complicated, and a protracted and long-drawn affair; for this, evidence (both for and against) must be systematically gathered and analyzed over a period in time, and uncertainties and paradoxes continuously and systematically unearthed.^{21 22 23 24}

A. Hawthorne experiments

The Hawthorne study began in the year 1924, lasted till 1927 and was carried out at a Western Electric plant in Illinois; these workers produced electrical relays. The study divided workers into two groups in order to analyze and assess the impact of various incentives on their productivity. The study also introduced Improvements to lighting and deduced that it led to increases in productivity. In fact, productivity increased with almost any change in lighting, including scenarios when lighting was withdrawn. In a slightly later study associated with Elton Mayo between 1928 and 1932, many changes to work structure such as rest periods, food during the breaks were included as well as increase and decrease in working hours. These studies were however considered to be methodologically poor; there were a large number of factors that were not taken into consideration, as worker productivity could be affected by many factors not neutralized in the study. It was also difficult to draw generalizations from this study, and pinpoint the underlying cause behind an observation with reliability. Interestingly, productivity almost always

²¹ Research Methodology: Tools and techniques, CR Kothari, New Age Publishers, Second revised edition

²² Research design: Qualitative, Quantitative, and mixed method approaches, John W. Cresswell, Fourth edition, Sage publishers

²³ Research Methodology: A step by step guide for beginners, Ranjit Kumar, Sage publications

²⁴ Research Methods, Second edition, William M K Trochim, Cornell University

increased when a new parameter was introduced, as well as when the parameter was withdrawn. According to a later interpretation by Landsberger, the novelty of being research subjects and the increased attention might have led to temporary increases in workers' productivity coupled with the fact that workers might have worked harder because they felt they were being observed. This interpretation was called "the Hawthorne effect". Other factors such as a choice of coworkers, working in a separate room, and having a sympathetic supervisor could have mattered, too.²⁵

B. Time and motion studies

A time and motion study is a kind of work efficiency study (forming an intrinsic part of the Scientific management technique or Taylorism developed by Frederick Taylor) that combines the time study approach of Frederick Winslow Taylor with the motion Study approach of Frank Gilbreth and Lillian Gilbreth. It seeks to define standard times (this is an essential component of time study), and improve work methods and work efficiency as well (this is an essential component of motion study). The two were later integrated and became an essential component of industrial engineering.

Time study is a structured observation of any task that is being performed, and typically makes use of any timekeeping device to record the time taken to accomplish a task and it is often used when there are repetitive tasks of the same nature being performed. It is also sometimes used when a wide variety of dissimilar work is being performed. According to the Industrial Engineering Terminology Standard, time study is "a work measurement technique consisting of careful and systematic time measurement of the task with any time measuring instrument, adjusted for any observed variance from the normal effort or pace and to allow for adequate time for factors such as foreign elements, unavoidable or machine delays, rest to overcome fatigue, and personal needs."

This approach chiefly and primarily seeks to transform management into a formal, measured and calculated technique. In addition to criticisms by unions, there are a wide variety of factors such as age, gender, experience, skill sets and health that may not have been taken into consideration and isolated in these studies, (along with pay scales and incentives) and distinct standards may not have been developed based on worker category. There may also have been a certain degree of subjectivity involved in assessment, as pointed out by Cadbury, Gilbreth and Marshall, and supervisor interpretation was often excessively relied upon. Since repeated observation is critical for time and motion study, the number of observation and the number of samples may have been inadequate; others felt this kind of a study was not suitable

²⁵ Levitt, S. D.; List, J. A. (2011). "Was there really a Hawthorne effect at the Hawthorne plant? An analysis of the original illumination experiments". *American Economic Journal: Applied Economics*. **3**: 224–238.

for non-repetitive jobs, and jobs requiring expertise or precision.²⁶

C. Gregor Mendel's experiments

Gregor Johann Mendel was a Austrian monk, friar and abbot with acute interests in biology and plant breeding, besides other interests in meteorology and astronomy. Gregor Mendel is widely known as the father of genetics because of his pioneering and ground-breaking work on inheritance in pea plants in the Nineteenth century. He was born in 1822, in a German speaking family, and at 21, he joined a monastery in Brunn. In 1856, Mendel began a series of experiments on pea plants in this monastery to determine how traits and characteristics were passed on from generation to generation. His experiments were carried out against the background of the then prevalent belief that two parents' traits were blended or combined together in their progeny. He studied dominant and recessive traits, and proposed the laws of inheritance, such as the law of dominance, the law of independent assortment, and the law of segregation. He proposed that dominant traits showed up in the progeny, while recessive traits did not: they were instead passed on to subsequent generations.

His work was widely ignored, possibly because it was written in German, and because his work was way ahead of the time. His work was more widely accepted in the early twentieth century, and after Mendel had died. Early critics of Mendel's work alleged that Mendel's observations applied only to pea plants. However, over the years, it became accepted that Mendel's laws were applicable to other species of plants and animals too. Major limitations of Mendel's work have also been identified over the years, as also exceptions to his rules. However, his work remains the bedrock of modern genetics.²⁷

D. What is the likelihood that Mahajanapadas are real?

The Mahajanapadas is a collective term that referred to sixteen kingdoms that existed in ancient north India in the Gangetic plains during the second urbanisation period of India. Early views pointed the rise of the Mahajanapadas to the rise of Buddhism. However, even senior archaeologists like the late Gregory Possehl have pointed out that urbanism in the Gangetic plains began much earlier. Such old views are also at odds with current observations that urbanism in the Gangetic plains began immediately after the decline of the Indus Valley Civilization after 1900 BC as settlements moved eastward as proposed by Piotr Andreevich Eltsov, Jim Shaffer, Dhavalikar, and others. The Rural post-Harappan India hypothesis and Wheeler's dark age hypothesis that held sway in early Indology must probably be considered non-starters because of several reasons such as the use of chariots which are not the vehicles of rural folk, and iron. Rural folk would have had no reason to

²⁶ Krenn, M 2011, 'From Scientific Management to Homemaking: Lillian M. Gilbreth's Contributions to the Development of Management Thought', *Management & Organisational History*, vol. 6, no. 2, pp. 145-161

²⁷ Schacherer, Joseph (2016). "Beyond the simplicity of Mendelian inheritance". *Comptes Rendus Biologies*. **339** (7–8): 284–288

produce works such as the Rig Veda (1500 BC) and more philosophical works such as the Upanishads (1300 BC). We have also traced the origin of Brahmi to an earlier West Asian source. The epistemology is also wrong: the absence of evidence certainly does not constitute evidence of absence, and in all probability, urbanism in the Gangetic plains began in 1900 BC after settlements moved from the Indus basin to the Gangetic valley, and these merged with minor settlements pre-existing in the Gangetic plains at that time.^{28 29}

E. What is the probability that Tamil is older than Kannada or Telugu?

Tamil-Brahmi, was a variant of the Brahmi script (and clearly related to it) in southern India. It was used to write inscriptions in the early form of Old Tamil. The Tamil-Brahmi script on potsherds, coins or even cave entrances has been dated between the third century BC and the first century AD, though others date it to around 500 BC. Early mentions of writing in Tamil have also been made in Jain works such as the Samavayanga Sutta and the Pannavana Sutta. The Tamil Sangam age is also dated to around 300 BC, and excavations at Keezhadi have reliably dated it to 300 BC; some more controversially posit earlier dates. Even though a version of the Brahmi script dated to around 300 BC has been found in Bhattiprolu in Andhra Pradesh, it represents a form of Prakrit, not Telugu. Therefore, Tamil is decidedly older than Kannada or Telugu, whose earliest inscriptions date to 450 AD and 575 AD respectively, at least based on current evidence. There is an abundance of literature in the Tamil Sangam age, and Telugu and Kannada did not break out into literary languages until several centuries after Christ, at least based on current evidence. This evidence would imply that the split up between North Indian Brahmi and South India Brahmi took place sometime before the age of Ashoka. Thus, development of scripts is a gradual process, and cannot be accredited to any one individual, king, or even dynasty. Fringe theories abound, and must be chastised; these state that Tamil (or even Sinhala) is the source of Brahmi. While theories on the origin of spoken languages are highly unreliable, all evidence seems to suggest that Tamil developed as a literary language and a written language ahead of other South Indian languages. However, the theory that Tamil is the oldest language of mankind, are highly unscientific given that the origin of spoken languages are dated to between 40000 and 60000 YBP. Pre-Sangam age kingdoms have also been proposed, even though there is very little evidence to support such claims.³⁰

²⁸ An encyclopaedia of Indian archeology Volume 1 by Amalananda Ghosh

²⁹ Tewari, Rakesh (2003) in The origins of Iron Working in India: New evidence from the Central Ganga plain and the Eastern Vindhya, *Antiquity*, Vol. 77, pages 536-544. England: ISSN 0003- 598X

³⁰ Hart, George L. "Statement on the Status of Tamil as a Classical Language" Archived 10 November 2018 at the Wayback Machine, University of California, Berkeley, Department of South Asian Studies – Tamil

F. What is the probability that Lemuria is real?

Lemuria was a hypothetical continent first postulated in the year 1864 by the zoologist Philip Sclater, (and developed by James Churchward, and others) which he claimed had sunk beneath the Indian Ocean. The theory, though based on a commonality of Lemur fossils in Africa and India, was always suspect from the very beginning, but was totally discredited with the discovery of plate tectonics and continental drift in the 20th century, particularly Alfred Wegener's theory of Continental drift proposed in 1912. Some occultists such as Helena Blavatsky however continued to subscribe to it, along with a diverse set of fringe scholars and new age scholars, and this idea came to be associated with pseudo-archaeology, and also greatly with Dravidian nationalism (Kumari Kandam is the name often given to it by Dravidian nationalists). It is often disturbing and highly troubling that such ideas and notions are presented in the garb of scientific knowledge, and it is necessary, as always to get to the root of the problem. We acknowledge that circumstances were different in the nineteenth century than they are now; there was then very little widespread dissemination of scientific knowledge among the common people, but we will continue to fight pseudo-science, pseudo-history and pseudo-archaeology in all their forms until our last breath. Ideas such as Lemuria may not die out quickly or easily, and continue to resurface from time to time, and in 2013, a group of archaeologists tried to breathe new life into it based on dubious evidence.³¹

G. What is the probability that Atlantis is real?

Atlantis is a fictional island first accredited to Plato and found in his works *Timaeus* and *Critias*. This idea subsequently had a great impact on literature, and is a classic example of how a minor idea (this idea is hardly central to Plato's work) can be blown out of proportion. Some amateur or less accomplished scholars later falsely and erroneously attributed it to historical tradition, notably Ignatius Donnelly and Janus Joannes Bircherod, and some even drew maps to represent the Atlantean empire, and pinpoint its location precisely. It also came to be associated with a grand lost civilization that was also seen as a perfect utopia in many respects of ways. (When mainstream researchers make dubious claims, Hindutva proponents (who, though must be severely criticized, are only a class of new age writers) and others can hardly be faulted!) Thankfully, the idea of Atlantis has passed out of the realm of legitimate science completely.³²

³¹ Hale, John R. (2009). *Lords of the Sea: The Epic Story of the Athenian Navy and the Birth of Democracy*. New York: Penguin. p. 368. ISBN 978-0-670-02080-5.

³² Ramaswamy, Sumathi (2004). *The Lost Land of Lemuria: Fabulous Geographies, Catastrophic Histories*. University of California Press. ISBN 0-520-24032-4.

H. *The Orion correlation theory*

The Orion correlation theory is considered to be a fringe theory in Egyptology that seeks to explain a possible purpose in the arrangement of the Giza pyramid complex, and was first proposed by Robert Bauval. It argues that there is a correlation between the location of the three largest pyramids of the pyramid complex in Giza, Egypt and Orion's Belt of the constellation Orion, and that this correlation was intentional and taken into consideration by the builders of the pyramid. It also postulates among other things, that the pyramids were built before 10000 BC, when the technology to build such structures could not have existed. The theory was published in 1989, and was universally rejected by mainstream researchers (It gained some acceptance among new age authors). It only goes on to show how individuals masquerading as bonafide researchers mislead the gullible, in order to benefit financially and commercially. It only goes on to show that the culture of science needs a complete overhaul, and such a metamorphosis or transformation needs to be comprehensive and multi-dimensional. Unfortunately, even mainstream television channels subscribe to sensationalism and do very little to disseminate true science. All this needs to change. New technologies such as the internet and smart phones can indeed play a vital role here, but still these still need to be consciously put to full effect.³³

I. *Erich von Daniken's theories*

Erich von Daniken is a controversial Swiss author with a highly controversial track record, who made claims about extraterrestrial influences on early human culture and civilization, and authored, among others, the best-selling books "*Chariots of the Gods*", published in 1968. Von Daniken also played a major role in popularizing the widely rejected paleo-contact and ancient astronauts hypotheses, which stated that extra-terrestrials visited earth in ancient times, and played a role in the development of human civilization, besides building well-known monuments on earth, including some monuments in India. Von Daniken's ideas have been completely rejected and discredited by almost all scientists and researchers, and his work is labelled as pseudoscience, pseudohistory, and pseudoarchaeology. It is universally accepted that Von Daniken's work is riddled with sloppy logic and erroneous conclusions throughout, and his lack of knowledge of scientific topics is obvious. Besides Von Daniken, even Carl Sagan and IS Shkovskii wrote about possible alien visitations to earth without a shred of evidence, and this epitomizes the sad state of affairs. Besides all this, even science fiction writers who became exceedingly wealthy, are culpable and guilty of misleading the gullible and the average common man in the street to make a quick buck; the man in the street is often utterly bewildered, and cannot differentiate facts from fiction. What can be done to stem the rot? Such books sell like hot cakes, and are found on virtually every shelf of a substantial or expansive personal or a college library. Unfortunately, on the other hand, good

³³ The Oxford Guide: Essential Guide to Egyptian Mythology, Edited by Donald B. Redford, p302-307, Berkley, 2003, ISBN 0-425-19096-X

science gets brushed under the carpet where it remains for aeons.³⁴

J. *The theory that Jesus lived in India*

The claim that Jesus Lived in India was first promoted by Nicolas Notovitch in 1894 (and elaborated on by Holger Kersten, and to some extent, others) who sought to throw light on unknown years of Jesus when he was between twelve and twenty-nine years old. According to this author, these years were spent in India. His claim was widely dubbed a hoax, and Holger Kersten's ideas were likewise rubbished. Even though he alluded to some Hindu mythology to draw support for his theory, such literature was shown to be of later provenance; his interpretations of Buddhist material were likewise debunked by Gunter Gronbold, and others. Interestingly, Kersten's work was a runaway success in scientifically-aware Germany, making him wealthy in the process. (Educated Germans also flock to new age gurus in India which shows that there is a continuing dichotomy between scientists and the general public across societies and cultures) They were less successful in India, as such theories mattered little to popular rival ideologies there. In sum, they were rejected widely by both Indological and Biblical scholars of various hues and colours.³⁵

K. *The shroud of Turin*

The Shroud of Turin, also known popularly and widely as the Holy Shroud, is a rectangular strip of linen cloth bearing the negative image of a man, dating way back to the year 1354. According to some, this is the image of Jesus of Nazareth and was the burial shroud in which he was wrapped after his crucifixion. The image on the shroud is somewhat unclear, but clearer in a black and white photographic negative than in its natural colour; the nature of the actual image is contested. The shroud of Turin was denounced in some Christian circles, while others maintain a more neutral stance. Radiocarbon dating has traced it to the Middle ages, and many researchers are sceptical about the claim that it is two thousand years old. The results of the radiocarbon dating have however been contested by others, who ascribe it to contamination. There is also no definite or reliable historical record of the shroud prior to the Middle ages. Thus, a lively debate among different scholars sometimes benefits science, but points of view must not be based on unfounded opinion, and objectivity must not be lost sight of. Once the truth has been realized, points of view are automatically relegated to the background.³⁶

³⁴ Chariots of the Gods? (Souvenir Press Ltd, 1969)

³⁵ Jesus lebte in Indien – Sein geheimes Leben vor und nach der Kreuzigung. Ullstein-Verlag, Berlin 1998, ISBN 3-5483-5490-4, (1. Auflage: Droemer Knauer, München 1983, ISBN 3-426-03712-2).

³⁶ Taylor, R.E. and Bar-Yosef, Ofer. *Radiocarbon Dating, Second Edition: An Archaeological Perspective*. Left Coast Press, 2014, p. 165.

L. Copernicus' Heliocentric theory versus earlier theories

Nicolaus Copernicus was a Renaissance polymath, who was also a mathematician, and an astronomer. He is accredited with having formulated a model of the universe that placed the Sun instead of the Earth at its center. His model, which is known as the Heliocentric model, is thus different from the old Geocentric model. Copernicus may have developed his model of Heliocentrism independently of the Greek scholar Aristarchus of Samos, who had formulated a similar model eighteen centuries earlier, but was widely ignored. There were several advantages of the Copernican model. For example, it explained the motions of stars, sun, moon just as clearly as the Ptolemaic model. It also provided a more natural explanation of planetary motion (without major epicycles). It also allowed calculation of sizes, speeds of planetary motion easily, and predicted positions of celestial bodies more accurately. Even though there were criticisms of the Copernican model, they were subsequently criticized, and shown to be false. Thereby, his model triumphed, and is widely accepted to this day.³⁷

M. Experiments on rodents

American researcher John B. Calhoun had been studying rodents since 1947. Between 1968 and 1970, he conducted a behavioral study of captive mice in a facility in Maryland in the USA. Several pairs of mice were bred, and their population soon increased to 2200. These mice established social orders that created factions, and eventually stopped mating completely, becoming hostile to each other. This could even lead to their eventual extinction. This study seemed to suggest that overpopulation led to a breakdown in social order; this theory was at times extrapolated to humans too, and has been controversial ever since, given that there were too many uncertainties involved, and the implication of this extrapolation were catastrophic. Likewise, theories such as Malthus' theories of population growth have been proven to be non-comprehensive, and many exceptions have been observed over the years. Other theories such as the Gaia hypothesis proposed by James Lovelock must also be put through this test, and exceptions identified, wherever possible. Early work by Greek scholars (Eratosthenes of Cyrene) on the measurement of the earth and claimed evidence for or against the old flat earth theory can also be adjudged using this method, as can also be every other experiment in the history of science. It can also be used to test every theory, statement or assumption, for example, the statement "People with a high IQ have a low EQ." It can also be used in evaluating statistical or non-statistical models of society, or any other mathematical or non-mathematical model for accuracy, comprehensiveness and reliability.

³⁷ Lucio Russo, Silvio M. Medaglia, Sulla presunta accusa di empietà ad Aristarco di Samo, in *Quaderni urbinati di cultura classica*, n.s. 53 (82) (1996), pp. 113–121

N. Theory of spontaneous generation or Abiogenesis

The theory of spontaneous generation of life is probably as ancient as human thought itself. It is a well known principle that life can arise only from pre-existing life (this is known as the principle of bio-genesis) and assumes that life originally arose from inert, inorganic matter due to physico-chemical conditions which probably existed during the evolution of earth. According to obsolete forms of this theory which have no currency today, frogs and salamanders may have arisen (spontaneously!) from coagulated slime; worms from manure; toad, snakes and mice from the mud of the river Nile; insects from dew, rotten slime, dry wood, sweat and meat, etc. Life must have however evolved from non-life at some point, and while some researchers postulate an external origin of life, the paradox still persists. There can be no easy answers to such questions, and the pros and cons of every paradigm must be constantly assessed and reassessed. Thus, these ideas in their original form are obsolete, just as Lamarckism is obsolete.³⁸

O. Theories in social and cultural anthropology

We will now evaluate a large number of theories and approaches in social and cultural anthropology from the point of the certainty uncertainty principle and the sociological ninety ten rules. Some of these concepts may fall flat, while others sail through admirably. In some case, techniques such as cross-cultural ethnography or cross-cultural research design may be called for, in the interests of a more reliable output. Given that ethnographic techniques were often used in these studies, altered techniques such as the participant driven approach, and annotated approach in ethnography may be used to better effect.³⁹

Ruth Benedict carried out her fieldwork among the Zuni, Cochiti and Pima tribes in America. Ruth Benedict studied different societies and described them in terms of their basic personality configurations. In her work, "Patterns of Culture" (published in 1934) she discussed, through literature, contrastive personality types between Zuni of the Southwest America and Kwakiutl of the Northeast Coast of North America. She also studied child training patterns and marriage patterns in these groups. She also went on to describe Zuni as Apollonian and Kwakiutl as, Dionysian after the Greek Gods of wine and light (i.e. wine as Dionysian and light as Apollonian) respectively. While her work was well-meaning and generally well-received, they may have been prone to stereotyping, over-simplification (since there could be many personality types within a group), and confirmation bias (viewed through the eyes of her own culture). We have therefore, proposed some techniques above to remediate such issues.

³⁸ Tessera, Marc (2011). "Origin of Evolution versus Origin of Life: A Shift of Paradigm". *International Journal of Molecular Sciences*. **12** (6)

³⁹ Presenting the 'Structured and Annotated Participantdriven Appraisal' technique in Ethnography: Towards the universal realization of Multivocality in Ethnographic studies Sujay Rao Mandavilli ELK's International Journal of Social Science Vol 4, Number 4, 2018

Another Anthropologist Margaret Mead also investigated the relationship between culture and personality. Her monograph “Coming of Age in Samoa” (published in 1949) made her famous. She also wrote about national character in some of her studies. Mead compared Samoan with American adolescent girls, and also studied stress related to puberty. She argued that stresses related to puberty were determined culturally, and not biologically, and that puberty in Samoa was a carefree experience. She also rightly argued that Samoan society treated adolescents differently from American culture, and there was very little shame in this respect in Samoa. Mead also subsequently studied the personality formation of the children of New Guinea with particular emphasis on the Manus tribe, which was published as “Growing up in New Guinea” (1930). In a later work, “Sex and Temperament in Three Primitive Societies” (1935), Mead compared three different cultures, namely Arapesh, Mundugumor and Tschambuli, to test variation of cultural patterns. She studied why societies living in same area differed in their character, personality and temperament. She also studied differences between males and females in this respect. According to her, people in Arapesh were submissive (both males and females), while in Mundugumor, they were aggressive. In Tschambuli males were submissive, and females were aggressive. These studies were carried out to satiate her intellectual curiosity, and were not carried out for any specific downstream economic (or non-economic) objective.

Another anthropologist, Cora du Bois studied the people of Alora in the East Indies. She collected information on child-rearing, and collected biographies as well. She also administered a wide range of projective tests such as the Rorschach Inkblot test to her subjects. Other specialists were then asked to interpret her projective materials separately. These were designed to eliminate her own cultural and personal bias, though readers can assess if some bias can still exist. These specialists then commented on the personalities of the Alor. She also traced Alor personality (people of Alor were suspicious and jealous) to the absence of maternal care, as women mostly worked in Alor. Her findings were published in the year 1945.

The famous influential work “The Chrysanthemum and the Sword: Patterns of Japanese Culture” is a 1946 study of Japan carried out by Ruth Benedict. Her analyses were requested by the US office of war information (during the Second World War) to understand and predict the behaviour of the Japanese. Her work was somewhat criticized, but continued to remain influential. According to her, the Japanese could be both aggressive and unaggressive, both polite and insolent, both aesthetic and militaristic, both adaptable and rigid, loyal and treacherous, submissive, but resentful of being pushed around. They were also timid, brave, hospitable and conservative.⁴⁰

⁴⁰ Abrahamson, Mark. 2001. ‘Functional, Conflict and Nonfunctional Theories’. In George Ritzer and Barry Smart (eds), Handbook of Social Theory. Sage Publications (pp. 141-51)

P. Anthropological theories on Functionalism

The twentieth century (particularly the 1920’s) witnessed the rise of functionalism (or Anthropological functionalism) in social and cultural Anthropology. A seminal work was by Radcliffe Brown in 1922 titled “The Andaman Islanders”, and the other, in the same year, by Bronislaw Malinowski, titled “Argonauts of the Western Pacific”. This approach held sway till almost half a century later, and also spawned many derivatives and variants. It posits that society is like any other system (examples being the atomic system, the solar system, or a mechanical system). Thus, a society consists of parts and components such as individuals, groups, roles, organizations, associations, and institutions, which are interrelated, interconnected and interdependent. Each part has a role to play in the functioning of the whole, and its existence is always justified. A society is not static but dynamic, and a change in one part brings about cascading changes to all other parts which are interrelated to it. A society is also always greater than the sum of its parts.⁴¹

Radcliffe Brown’s approach came to be known as the Structural Functional approach. He defined each society as a ‘functionally interrelated system’ in which general laws or functions operate. He also spoke about the necessary conditions for existence, and that society continued to exist unlike an organism which dies. Radcliffe-Brown’s structural-functional approach comprises several assumptions, such as: a) a pre-requisite for the survival of any society is a minimal integration of its parts. b) The concept of function refers to processes that seek to maintain a necessary solidarity or integration. c) and that in every society, structural features contribute to the maintenance of the necessary solidarity. Radcliffe brown also spoke about the structural continuity of society. In comparison to Radcliffe-Brown, Bronislaw Malinowski claimed to have created a separate school called the ‘Functional School’. According to Malinowski, the aim of functional analysis is to arrive at explanations for anthropological facts by their function, and in relation to the role they play as well. Thus, it can be always assumed that every idea, custom or material object plays a role in society. While Radcliffe-Brown begins with society as a starting point, Malinowski’s starting point is the individual, who has a set of basic or biological needs to be satisfied for his survival. Thus, Malinowski’s approach, which also talks about the biological level, the symbolic level, and the social structural level, is that of psychological functionalism. Culture is also the foundation of Malinowski’s approach; on the other hand, it is secondary to Radcliffe Brown.

One of the building blocks of Malinowski’s approach is a theory of ‘vital sequences’, which have a biological foundation and are incorporated into all societies. There are eleven sequences, each comprised of an ‘impulse’, an associated physiological act, and a resultant satisfaction which results from that act. The impulses according to Malinowski are the drive to breathe, hunger, thirst, sex

⁴¹ Alexander, Jeffrey C. 1982. Positivism, Presuppositions and Current Controversies. Theoretical Logic in Sociology. Vol. 1. Berkeley: University of California Press.

appetite, fatigue, restlessness, somnolence, bladder pressure, colon pressure, fright and pain. On the other hand, Talcott Parsons, Robert Merton are referred to as arch-functionalists, who oppose the term structural-functionalism. According to arch-functionalists, structure could refer to any set of relations among parts of a living system. Arch-functionalists also developed the AGIL model, (Adaptation, goal attainment, integration, and latency (pattern maintenance and tension management). Even though neo-functionalists such as Niklas Luhmann and Jurgen Habermas, attempted to reconcile ideas, diverse view points remain. Thus, even here, as in all sub-fields of cultural and social anthropology, we find excessive theorization and non-reconciliation of view points over a protracted span of time. Students of Anthropology are forced to cram their brains with a large quantum of information, while basic concepts are sidelined, or not highlighted. They are definitely also not presented to students in a crisp or a concise form, who could definitely benefit greatly from such an attempt. Criticism of theories, is also not systematic, logical or structured, and is often carried out with vendetta, or to push another point of view.^{42 43}

VII. THE RACE IQ DEBATE

There is probably no such thing such as race. The idea of race and racism has had a long history, and we discuss it briefly below:

The Anthropological Society of Paris, a pioneer in its field, was founded in 1859 by Paul Broca. He, like Samuel Morton based his activities on racial Craniology. Thus, the principles of polygenism were developed, and it was postulated that humans were a polytypic species. In general, they opposed the idea of degeneration, and some Anthropologists like Rudolf Virchow also believed, that variations in human form were due to disease and nutrition. The field of Anthropometry or a scientific study of human measurements was further developed due to the efforts of Karl Pearson, Blumenbach and others who also studied metrical and morphological traits. However, the principle of racial determinism that assumed that Caucasoids, or European populations were superior was widely and implicitly believed in at that time.

Classification of humans into taxonomies was also popular, and different Anthropologists adopted different classifications. For example, Francois Bernier was among the earlier to divide humanity into races. Blumenbach, based on his observations, classified humans into Caucasian, Mongolian, Ethiopian, American and Malay (Polynesian, Melanesian, and aborigines of Australia), and this classification was similar to that of Karl Linnaeus. Coon et al In his magnum opus *The Origin of Races* published in 1962, distinguished six groups of mankind namely the Negroid, Mongoloid, White, Australoid, American Indian

and Polynesian which were further grouped into thirty races. Coon further argued that modern humans (*Homo sapiens*) arose through five separate lines from *Homo erectus*, into the Caucasoid, Mongoloid, Australoid, Congoid and Capoid. He also postulated that different racial groups were at different levels of evolution at any given point in time, (multi-linear racial development) and whites were naturally the most evolved. He effectively instituted scientific racism, and his work was different from the ideas of monogenecists such as Robert Boyle who proposed that all humans evolved from Adam and Eve. Coon's work was extended by Garn who proposed a more dynamic classification. Other researchers such as Sherwood Washburn and Ashley Montagu proposed a continuous "serial" progression of human populations, rather than the notion of "parallel" genetically distinct races, and Julian Huxley too criticized efforts to arrive at a "zoological" nomenclature for humans.

In the view of early anthropologists, races were determined by factors such as facial type, skin colour, cranial profile, physical build and stature, and texture and colour of hair as also moral character and intelligence. Others proposed that blood groups be used in the classification of humans, and even derived categorizations based on such criteria. Some others emphasized that genetics be used as the basis of classification rather than skeletal analysis. Over a period, terms such as ethnic group, ethno-biological identity, and haplogroups became more popular, and terms such as race fell into gradual disuse. It was also eventually postulated that classifications were not static or fixed entities but dynamic units that constantly changed based on human interactions. In 1950, UNESCO issued a statement which included a scientific opposition to race theories and a moral condemnation of racism as well, and suggested replacing the term 'race' as 'ethnic group'. Livingstone in his article "On the non-existence of human races" written in 1962, showed that the static typological notion of races was incompatible with the dynamic concept of natural selection, and therefore opposed the concept of races. He therefore proposed the concept of geographical variation of single traits, or "clinal variation." Thus, "there are no races, there were only clines". Differences arise among human populations because all the forces of biological diversity such as mutation, natural selection, genetic drift and hybridization operate in many different ways in different contexts, in many permutations and combinations along with other concepts such as bottlenecks (associated with events such as the Toba catastrophe event, for example) and the founder effect.⁴⁴

Scientific racism or biological racism has often been dominant in the west, though it is now mostly seen as a thing of the past. The "Essay on the Inequality of the Human Races", is a racist and what is often considered to be a pseudo-scientific work by French writer Joseph Arthur, Comte de Gobineau. This work is probably the world's earliest example of scientific racism. In this book, the author argues that there are intellectual differences between human races, that civilizations tend to decline due to the

⁴² Davis, Kingsley. 1959. 'The Myth of Functional Analysis as a Special Method in Sociology and Anthropology'. In *American Sociological Review*. 24: 757-72.

⁴³ Barnard, Alan. 2000. *History and Theory in Anthropology*. Cambridge: Cambridge University Press

⁴⁴ Boaz, N.T and Almquist, A.J. 1999. *Essentials of Biological Anthropology*, New Jersey, Prentice Hall

admixture of races, and that the white race is superior to the other two races he defined, namely black and yellow. He also pointed out the superiority of the “Aryan” race”, a concept that was wrongly understood by many early Indologists, and misused by Hitler and others to a very great degree. Gobineau also misused many concepts and ideas in Anthropology to support his case. Gobineau’s work found some support in Europe and North America and encouraged other writers to develop similar racial theories. The American scientist and slave owner Thomas Jefferson vehemently argued that blacks were inferior to whites, and called on scientists to settle the matter once and for all. Some like Arthur Schopenhauer attributed white supremacy to climatic conditions. Not all Europeans believed in scientific racism. For example, Friederich Tiedemann argued that there was absolutely no evidence that suggested that blacks had inferior intellect than whites. Eugenics is another controversial movement promoting purification of races, and many European and American intellectuals supported Eugenics in some form.

“The Bell Curve: Intelligence and Class Structure in American Life” is a highly-controversial 1994 book authored by psychologist Richard J. Herrnstein and political scientist Charles Murray. In this book, the authors argue that human intelligence is greatly influenced by both inherited and environmental factors and that intelligence determines other outcomes, including financial income, job performance, work productivity, birth outside of wedlock, misdemeanour, and involvement in crime. They argue that intelligence determines these outcomes more reliably than an individual’s socio-economic background. This book also presents a thesis regarding ethnicity and intelligence. They authors argue that Asians had a higher IQ score than whites, who in turn has a higher IQ score than blacks. This does not mean that the difference is purely genetic, they state. This book also talks about a “cognitive elite” in detail, who were wealthier than most Americans not belonging to this category. This book was widely criticized often for the absence or lack of rigorous peer-review, including by stalwarts such as Stephen Gould, Noam Chomsky, Thomas Sowell, and others, even though it had a few supporters, and criticisms were subsequently published in the book “The bell curve debate”.

The book “IQ and Global Inequality” is a highly controversial 2006 book authored by psychologist Richard Lynn and the political scientist Tatu Vanhanen, and published by a white supremacist publisher. “IQ and Global Inequality” is follow-up to their 2002 book “IQ and the Wealth of Nations”, a follow up of their argument that international differences in current economic development are due to an extent to differences in average national intelligence as indicated by national IQ estimates. The authors argued that IQ differences as shown by IQ tests, also led to differences in adult literacy, tertiary education and life expectancy, besides nutrition and healthcare. These conclusions are of course, highly in doubt. This book was highly criticized, and critics referred to its methodology and conclusions for criticism. The follow up work “IQ and Global Inequality” responded to some of the criticisms levelled against the author’s first book. In the second book,

they also measured IQ using two different methods, and correlated IQ to achievements in Maths and science. Critics could also point out to the reliability of IQ tests themselves which may not account for cultural variations, enculturation patterns, inferiority or superiority complexes (caused by physical characteristics or upbringing) which we believe can play a major role in determining outcomes, desire for achievement, peer-influences, secondary environment, occupational differences, differences in linguistic ability, nutrition and dietary habits (which could impact physical or mental ability), or differences in what we have called mind-orientation, which itself may be caused by a wide variety of factors (for example, western cultures may place a greater emphasis on individuality and computational capacity, while some oriental cultures may promote cultural or environmental harmony, and family values over achievement), and in spite of a wide diversity in IQ tests used, these factors may lead to differences in IQ scores reported. Additionally, lower caste Hindus were subject to discrimination historically, and this may have led to a reflex action. There are also limited options for high-end scientific careers in countries like India, and the Indian education system as such is not geared for innovation or creativity. Properly conducted scientific experiments must systematically negate all these factors.

IQ tests are also not infallible, as differences can show up if IQ tests are performed repeatedly. Debate on race and IQ has barely died out in the United States and elsewhere. Indeed if persists to a very high degree, and often generates more heat than light. For example, Law Professor Amy Wax’s recent statements that blacks lacked ability, and never graduated in the top half of her class, drew both brickbats and some support.⁴⁵

The work of Lynn and Vanhanen was also criticized for conformation bias and inadequate sample size by many researchers. Earl Hunt in particular has pointed out to the dangerous implications of their work, and the potential to make irresponsible policy decisions on the basis of such work. In 2020, the “European Human Behaviour and Evolution Association” issued a formal statement opposing the utilization of Lynn’s national IQ dataset for secondary downstream analysis, citing methodological concerns in their work. From our perspective, tests must take all possible criticisms into consideration; for example, it has been shown that blacks raised by white parents often reported higher scores, but these may not consider factors pertaining to discrimination in the school or learning environment, which may hamper performance in the long term. IQ scores by nationality are even less reliable as there are many cultural, or ethnic groups in nations. Large datasets must always be used, and tests must be repeatedly redesigned to take into consideration all forms of criticism.

The Flynn effect refers to a substantial and a sustained increase in IQ scores over the decades as based on samples from different parts of the world. This aspect also needs to be borne in mind while evaluating IQ. Test score increases

⁴⁵ "Reflections about intelligence over 40 years" (PDF). *Intelligence* (70): 73–83. 2018

have been continuous and linear from the earliest years of testing to the present day. British children's scores have risen by 14 IQ points between 1942 and 2008. This is biologically impossible. This finding therefore demonstrates the impact of non-biological factors on IQ scores. However, other factors such as improved education, and increased knowledge can also play a role in explaining this increase. This is indeed possible, as the reverse Flynn effect in certain countries possibly demonstrates. Supporters of the Flynn effect could argue that IQ levels in African countries could eventually reach European levels, and as increases in IQ levels in developed countries taper off, there could be a convergence. Supporters of the Flynn effect argue that differences in IQ scores between blacks and whites has indeed been reducing over the years. Scientific tests must be designed taking into consideration all the criticisms mentioned above, both by us, and by other scholars. Additionally, a 'cross-cultural research design' approach may also be used as it would serve our purpose extremely well. Other factors must also be systematically eliminated. For example, while there is indeed a difference in the brain sizes of hominins in various parts of Africa, this could easily be attributed to low sample size, which would be the most reliable underlying cause. In a majority of cases, sample size was just one, making any study from the data (which in any case pertains to just one region) obviously highly unreliable. Proponents of race and IQ difference must also explain how and why melanisation and skin pigmentation can be related to brain size, or cognitive ability.^{46 47}

The certainty uncertainty principle can also be used to provide answers to questions such as "Why is Africa backward?" or "Why is the intellectual output in India poor?". All the points we have raised in this paper must be systematically eliminated in order to arrive at the truth. Tests must also always designed to isolate cultural, nutritional, environmental and motivational factors from biological factors, as biological factors can be misused greatly to promote racism, bigotry, prejudice and hatred. Sample sizes must also be above an accepted threshold, and sampling strategies representative of all kinds of data must be used.^{48 49 50}

VIII. CONCLUSION

While the concepts presented in this paper, are not entirely new, we believe they are a logical extension and culmination of the concepts we have presented this far; every theory idea postulate or paradigm must be consciously and systematically assessed and reassessed either through self-scrutiny, or a non-biased third party analysis, keeping in mind concepts such as ideological-neutrality, and cultural neutrality. This must become a habit and a mindset, such that when anybody attempts to misuse science, he must be told, "refer to the certainty uncertainty principle", or to the "sociological ninety-ten rule". At the same time, scientists must also provide a "cultural frame of reference" for various cultures to edge out pre-scientific beliefs. For all this, trend-making and path-breaking researchers must lead by example, and show the way for other researchers. This can ensure that scientific activity is respected, appreciated and admired not just in western contexts, but all over the globe. This would also make scientific activity much more meaningful, besides leading to faster scientific progress. As always, the needs to science, society, and the education system must be kept close to heart, as delineated in our paper on social responsibility and academic freedom. The guiding principle behind any scientific endeavour or enterprise must always be service to science and society as a whole; this must override all other considerations at all times.

⁴⁶ Montagu, Ashley (2002). *Race and IQ* (2 ed.). New York: Oxford University Press. ISBN 978-0-19-510221-5.

⁴⁷ Cultural Anthropology by Barbara Miller, Sixth edition, PHI learning private limited, New Delhi, 2011

⁴⁸ Social Responsibility over Academic freedom: Emphasizing Ethics and Codes of Conduct geared for a Scholar's duties towards science, society and the education system in Twenty-First Century Science Sujay Rao Mandavilli IJSRT September 2022

⁴⁹ Cultural Anthropology: Appreciating cultural diversity, McGraw Hill international edition, Fifteenth edition, Conrad Phillip Kottak

⁵⁰ Anthropology, Twelfth edition, Carol R Ember, Melvin Ember, Peter N Peregrine, Pearson Prentice Hall, 2008