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Towards 360 Degree Approaches to Hypothesis Formulation and Evaluation: Another Epochal Milestone in Twenty-First Century Science

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Abstract:The main objective of this paper is to present the 360 degree approach to hypothesis formulation and evaluation. The main reason why we present this approach is because we believe that existing approaches are somewhat inadequate, and because scientific method may itself be somewhat in need of an overhaul. We begin this paper by defining research, research design, and by reviewing existing approaches to hypothesis building and formulation. The core essentials and the barebones of our approach are also then detailed, along with some of our supplementary proposals. Therefore, the multiple independent hypothesis model is presented as a part of this paper along with its core concepts and hypothesis evaluation mechanisms. This is also additionally achieved and accomplished by means of a few suitable illustrative examples. Lastly, the core concepts of logic are explored along with their bearing on the concepts and core essentials of this paper. We do hope, expect and anticipate that this paper will become a core and an intrinsic component of twenty-first century science.

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I. INTRODUCTION

*"*When general observations are drawn from so many particulars as to become certain and indubitable, these are jewels of knowledge" – Samuel Johnson

"Science is a way of thinking much more than it is a body of knowledge. This elevates research to a dynamic process of critical thought. " – Carl Sagan

The main objective of this paper is to present the 360 degree approach to hypothesis formulation and evaluation. The main reason why we present this approach is because we believe that existing approaches are somewhat inadequate, and because scientific method may itself be somewhat in need of an overhaul as its core constituents are somewhat ageing. We begin this paper by defining research, research design, and by reviewing already existing approaches to hypothesis building and formulation. The core essentials and the barebones of our approach are also then detailed, along with some of our supplementary proposals. Therefore, the multiple independent hypothesis model is presented as a part of this paper along with its core concepts and hypothesis evaluation mechanisms. This is also additionally achieved and accomplished by means of a few suitable illustrative examples which we believe are inherently interesting. Lastly, the core concepts of logic are explored along with their bearing on the concepts and core essentials of this paper. We do hope, expect and anticipate that this paper will become a core and an intrinsic component of twenty-first century science.

In this paper, we propose and present 360 degree approach to hypothesis formulation and evaluation. But what exactly is a 360 degree approach? A 360-degree angle or turn refers to a complete circle or a complete rotation, which represents all the 360 degrees constituted in a circle. It may also mean returning to the starting point after a complete 360 degree rotation or a paradigm or a framework which encompasses all aspects of something, and is therefore comprehensive, holistic and well-rounded by its very basic and intrinsic definition. When we refer to a "360-degree view" or "360-degree feedback," we mean that we have considered all possible perspectives, information, or aspects of a situation. We also have for example, a 360-degree employee performance appraisal, a 360 degree review of a strategy or a plan, or a 360 view of a business which would obviously include many definitive aspects such as employee feedback, customer feedback, internal processes, and market conditions, thereby leaving no stone unturned, or nothing to chance. It would in some ways, constitute a composite approach, and a comprehensive approach to boot. It would also constitute an end to end approach, and a structured approach. It would also constitute a tempered approach and a sequential approach, or one that is organized as a series of distinct and easily understandable steps that can also be logically and sequentially executed. To structure in this context means to construct or arrange according in accordance with a clear plan or direction; it also means to give a pattern or organization to something.

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Our approach we believe, would constitute a kaleidoscopic approach. But what exactly is a kaleidoscope? A kaleidoscope in simple and everyday parlance refers to an optical instrument having two or more reflecting surfaces with coloured pieces of glass, and tilted towards each other at a certain angle to obtain symmetrical patterns when viewed from the other end due to sequential reflection. A kaleidoscope therefore is designed in such a way that one or more objects on one end of these mirrors are shown as a beautiful symmetrical pattern when viewed from the other end, due to repeated rounds of reflection. The term kaleidoscopic in simple English, and not referring to an optical instrument, means having complex patterns of colours; in other words, it means multicoloured. We may also refer to the acronym VIBGYOR here, with refers to the seven colours of the rainbow. One may also refer to the obsolete and defunct view master here; one that was commercially introduced in 1939, long before the television was popularized. The term 360 degree as such is only a handy moniker, and we may not need a more specific name to describe our concepts and our proposals. The term also naturally means broad and diverse from our perspective. [1] [2] [3] [4] [5] [6] [7]

- *What is research?*

The term "research" is widely used in many walks of every life. But what exactly is research, more specifically scientific research? Research is nothing but a systematic process of gathering, analyzing, and interpreting a diverse set or series of systematically gathered data or information with a view to enhancing understanding of a specific topic or a problem of concern. Research also represents a structured, systematic, organized or a highly methodological approach to discovering new knowledge, testing and validating theories and hypotheses, or solving practical and real-world problems and issues. It may also lead to new hypotheses and theories being developed. Research is commonplace and is fundamental and intrinsic to many different fields of science, including physical and the biological sciences, social sciences, humanities, management studies, and applied sciences or technology. Research inevitably leads to the creation of new knowledge and the use of existing knowledge in new and creative ways to generate new concepts, methodologies and conceptual frameworks. Research also leads to the discovery of new facts, information, or the validation and ratification of data to produce new paradigms.

Research is a continuous activity in majority of disciplines and professions, and many organizations cannot survive, thrive, flourish, or prosper in the long-term without meaningful and pertinent research. Research is useful in the critical assessment of methods and methodologies, and leads to new, creative and innovative ways of doing things, which are often more robust, interdisciplinary and economical. According to a definition provided by John W Best, research is a "systematic and objective analysis and recording of controlled observations that may lead to the development of generalizations, principles, or theories, resulting in prediction and possibly ultimate control of events". In the words of Clifford Woody, research comprises "the continuous definition and the redefinition of problems, formulation of new hypotheses, the collection, organization and evaluation of data, and arriving at conclusions logically, sequentially and systematically in order to arrive at desired outcomes". The eminent researchers D. Slesinger and M. Stephenson define research in the following manner, "Research is the manipulation of things, concepts or symbols for the purpose of generalizing to extend, correct or verify knowledge, whether that knowledge aids in construction of theory or in the practice of an art." Others such as LV Redman, AVH Mory, and CR Kothari have also attempted definitions of research, though these are similar to the ones stated above, and need not be cited in the interest of brevity. Therefore, dynamism and the creation of new and useful forms of knowledge are central to all these definitions. Research encompasses several characteristics such as systematic investigation, data gathering and analysis, (also manipulation or purposeful handling) self-discipline, rigour, precision, the desire to do good to society, the advancement of knowledge for the greater common good, critical thinking, and problem solving among other things. Advancement of knowledge typically includes creation of new knowledge or new forms of knowledge, knowledge correction or knowledge verification. Research must also be objective and unbiased, logical and analytical, purpose-driven, and must produce reproducible and consistent results.

We also have different types of research such as basic and foundational research, applied research, action research that is geared to solving real world problems and issues, etc. We also have qualitative research, quantitative research, and mixed methods research. Research may also be classified into descriptive research, exploratory research, experimental research, and correlational research. .The research process consists of a series of sequential steps – mostly in the same order – that includes identification of a problem, review of literature, preparation of research design methodology, collection of data, analysis of data, interpretation of research findings, publication of research findings, and communication of results. Research must also have a moral

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[5] Cozy, Baker (2001). *Kaleidoscope Artistry*. USA: C&T Publishing, Inc. p. 144

[6] Mary Ann & Wolfgang Sell and Charley Van Pelt, "View-Master Memories" , M.A. and W. Sell, ISBN B0006S314I, 2000 Self-Published

[7] Gretchen Jane Gruber: *The Biography of William B. Gruber*. Mill City Press, Inc., 2015

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and an ethical compass, and from our point of view be interdisciplinary and cross-cultural. Transparency, internal and external validity, and attention to detail are also extremely important. We had listed out all the criteria of good research in a paper entitled "Advocating output criteria based scientific and research methodologies: why the reliability of scientific and research methods must be measured based on output criteria and attributes", a paper that was published by us in 2023. In addition, we had also talked about "Objectivity in mindset", a topic that we had harped upon ad nauseum. [8] [9] [10]

➢ *What is research design?*

Research design as noted by Kerlinger, Thyer, Selltiz and others, is a comprehensive and well-structured integrated conceptual plan or systematic and methodological framework for conducting a purposeful research study, and one that resembles a design arrangement. A research design for all practical purposes, outlines the strategies and methods that are to be used for the purposes of gathering, sorting, analyzing, interpreting and reporting data in order to answer research questions quickly, effectively, and efficiently, including critical who, why, what, where and how questions that essentially define the study. A research design also serves as a guide that sets the direction and the tempo for the entire research process from the cradle to the grave. It also serves as a template or a blueprint for a research project, ensuring that a logical, consistent and a coherent approach to addressing the research problem is envisaged, conceptualized and applied. In sum, the research problem and the research question must also be clearly defined, and the preconditions and exceptions stated as well. Research designs can be of many different types such as experimental design, descriptive design, qualitative design, quantitative design, and correlational design. In the interests of time and space, we will not get into all these concepts here. We also have concepts such as randomized control trials, experimental research design, quasi-experimental research design, double control group research design, single blind and double blind studies, before and after interventions studies, after only interventions studies, etc, all of which are beyond the scope of this paper.

Let us now attempt to answer the question of what a scientific method is. A scientific method is a systematic approach to gaining knowledge that involves a series of loosely defined steps such as observation, data gathering, hypothesis formation, experimentation, (Design of experiments, experiments and quasi-experiments) hypothesis refinement, data analysis, and arriving at a set of meaningful conclusions. Scientific method is a systematic process that is used to formally investigate real-world issues and answer questions through the mechanism of logic, reasoning, inference and evidence. We also believe that there is an urgent need to improve scientific method, and we have been working tirelessly in this direction for the past several years now. This is why we had published over twenty papers towards the attainment and fulfillment of this singular objective. Knowledge is also often stated to be the foundation of science, and knowledge is dependent on knowing which in turn is dependent on an external reference or fact. Human knowledge also may take on the form of beliefs about a particular fact, phenomenon or observation. However, the science of knowledge or epistemology is based on justified true belief. However the Gettier problem advanced by Edmund Gettier states that JTB does not account for all the necessary and sufficient conditions of knowledge. Hence, it may be called into question. [11] [12] [13] [14] [15]

➢ *What is a hypothesis?*

A hypothesis is a proposed initial explanation for a phenomenon, and one that more often than not, subject to further investigation, reinterpretation, revision, or scrutiny. For a hypothesis to be considered scientific, it must be based on real-world observations and data, and must be able to make testable and reproducible prediction about reality, in a process beginning with an initial but educated guess or thought. The next stage after a hypothesis is a scientific theory. If a hypothesis is repeatedly demonstrated by experiment to be true but usually under controlled conditions, it becomes a a valid and a bonafide scientific theory. In some cases, the words "hypothesis" and "theory" may be used loosely and interchangeably, but this must not be condoned in twenty-first century science. There are many different types of hypotheses too. A working hypothesis is a highly tentative hypothesis that is used for the purpose of pursuing further progress in research, and may be discarded later on, if found inadequate or insufficient. Conservative researchers tend to classify initial hypotheses as working hypotheses from the start, and eschew more conclusive declarations. This is a good working model from our perspective. For example, Konkani has been classified as an Indo-Aryan language by many researchers. This may be a faulty and an untested assumption, and can only be ratified from a historical deep dive. Konkani may well be a language isolate with Indo-Aryan language influences. However,

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[14] Rodrigo Borges, Claudio de Almeida, and Peter D. Klein (eds.), *Explaining Knowledge: New Essays on the Gettier Problem*, Oxford University Press, (Oxford), 2017

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conservatism is often shown the back door, and an element of subjectivity and researcher bias is allowed to creep in into the research process.

Hypotheses have been defined in many different ways by different researchers and thought leaders. The most simple definition of a hypothesis is that it is a tentative explanation of the mechanism, the dynamics, and the inner workings of the research problem, or an educated guess about the causes and effects of the problem, or even predictions of research outcomes. According to a definition provided by the researchers Goode and Hatt "a hypothesis is a proposition which can be put to test to determine its validity. Hypotheses are therefore, single tentative guesses, good hunches – assumed for use in devising theory or planning experiments intended to be given a direct experimental test when possible". According to another definition provided by Lundberg, "A hypothesis is a tentative generalization, the validity of which remains to be tested. Others such as Bogardus, PV Yaung, and FN Kerlinger have defined a hypothesis on more or less similar lines, albeit with minor variations. In its most elementary stage, the hypothesis may be any hunch, guess, imaginative idea, which becomes the basis for action or investigation". It can also sometimes be stated that a hypothesis begins with a hunch, suspicion, assumption, assertion or an vague or unambiguous idea about a phenomenon, set of relationships or situations, even stemming from a gut feel or intuition in rare cases, the reality or truth of which the researcher is not fully or completely aware to begin with. A researcher may even be forced to make assumptions in his early days, though these are mostly eventually justified or ratified such that a degree of overwhelming concreteness is eventually achieved. (Henn et al, 2006) [16] [17] [18]

In most scientific studies, a hypothesis is based upon a set or a series of observation. While hypotheses generation and hypothesis formulations are desirable, they are not entirely essential and may be dispensed with in a limited number of cases especially of the objective of the research is fact-finding. We do not however, mostly support the latter. This is because hypothesis formulation offers some distinct advantages. First of all, the formulation of a formal and well-defined or well-laid out hypothesis provides a study with a great deal of focus, clarity and direction, by clearly pre-stating objectives, and preempts loss of direction or unfastened loose ends. It also informs the researcher what specific aspects of a research problem to focus or emphasize on and to specifically investigate, and what elements to give the short-rift. It also acts as a guide for the data collection process, and the analysis and interpretation of data. It is also often capable of being tested mathematically through the use of independent, intervening and dependant variable. The entire exercise of hypothesis formulation provides added meat, substance, and impetus to a research study, even in situations where the hypothesis itself is discarded or jettisoned. The latter must be extremely rare from our perspective, as hypotheses must be robust enough, and must be constructed on reasonable premises.

A good hypothesis can be derived from a thorough theoretical grasp of the scientific process – however, prior experience in research. Before a hypothesis is formally constructed, a thorough grasp or knowledge of the problem along with literature review or a proper pilot study will help in the gradual refinement of the hypothesis. Researchers must also possess an eminent degree of common sense, and an alert, keen and an acute mind. A good hypothesis is also normally testable, and is expressed in the form of a statement, not a question. It must be unambiguous, and must possess a great deal of conceptual clarity. A good hypothesis must also not be generally inconsistent with known facts or observations, and a researcher must have already carried out a review or primary or secondary literature. From our perspective, hypotheses must be as robust and comprehensive as practically possible – as robust and comprehensive as the data and the evidence will allow - from the start. Erroneous or half-baked hypotheses can lead to misleading conclusions. They can also magnify errors disproportionately. That is why hypotheses must be reasonably strong and in a testable format from the very start. We must also clearly state the difference between hypothesis and a hunch from the very beginning or the very start. A hunch is a thought or an idea that is primarily based on feeling rather than on reliable facts or information. We must also state the difference between hypothesis and a conjecture. To conject6ure means to randomly or half-heartedly guess about something without real or concrete proof or evidence. This is akin to mindless speculation. Conjectures and hunches may be based on gut feel. While gut feel just like intuition may have its merits, it must be subsequently thoroughly revalidated, and as such clearly lies in the pre-hypothesis stage. [19] [20] [21] [22] [23]

Let us now review the different types of hypotheses. The first categorization is that of a simple versus a complex hypotheses. While a simple hypothesis proposes a

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17 *Hempel, C. G. (1952). Fundamentals of Concept Formation in Empirical Science. Chicago: University of Chicago Press*

18 Popper, Karl R. (1959), "The Logic of Scientific Discovery", Physics Today, 12 (11): 53

19 Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd edition). Thousand Oaks, California: Sage Publications

20 Joubish, Farooq Dr. (2009). *Educational Research* Department of Education, Federal Urdu University, Karachi, Pakistan

21 Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd edition). Thousand Oaks, California: Sage Publications.

22 Silverman, David (Ed). (2011). *Qualitative Research: Issues of Theory, Method and Practice*, Third Edition. London, Thousand Oaks, New Delhi, Singapore: Sage Publications

23 Advocating output criteria based scientific and research methodologies: Why the reliability of scientific and research methods must be measured based on output criteria and attributes Sujay Rao Mandavilli IJISRT, August 2023

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relationship between one independent and one dependent variable, a complex hypothesis deals with the relationships between multiple independent and dependent variables. In statistical hypothesis testing, a simple hypothesis specifies a single value for a population parameter, while a composite hypothesis specifies a range of values for the parameter. A directional hypotheses specifies the direction of the relationship between variables, while a non-directional hypothesis does not. A null hypothesis states that there is no significant relationship or difference between variables while the alternative hypothesis states the exact opposite. We also have other types of hypothesis which we would like to examine in brief. An associative hypothesis suggests that variables tend to vary together, but this does not automatically imply causation. A causal hypothesis on the other hand, proposes that changes in one variable directly trigger or induce i.e. cause, changes in the other variable. Statistical hypotheses are those hypothesis used for statistical tests through the ANOVA method, while non-statistical hypotheses are not. [24] [25] [26]

A research hypothesis is a statement about the general relationship between variables that the research seeks to uncover or investigate. An empirical hypothesis is one that is developed based on observations and experiments, while a logical hypothesis is based on logical reasoning and deduction. The ANOVA test developed by Ronald Fisher, investigates which of the hypotheses is true. i.e. the null hypothesis or the alternative hypothesis. It also specifies the type I error, and the type II error. It has two variants namely the one-tailed test, and the two-tailed test, and sometimes, the z-test and the t-test are also used. For example we may want to investigate whether vegetarians have higher blood sugar levels than non-vegetarians, or whether meatatarians have higher cholesterol levels than vegetarians. In such cases, variations within samples must be measured, and compared with variations across samples. [27] [28] [29]

Grounded theory is a yet to become widely popularized qualitative research approach that is used to develop new hypotheses and theories by carefully and systematically examining and analyzing data, and establishing a clear linkage between the two. This approach was first developed by Glaser and Strauss in the 1960's, and subsequently extended by other researchers. Unlike traditional research that tests or validates pre-existing hypotheses, grounded theory first begins with data collection procedures, continues with inductive analysis, and then allows theories to logically emanate from the results of data analysis. This is essentially an iterative process involves constant comparison of data, and drafts of findings to formulate and construct theories. Our approach has some similarities with this approach, though it is by no means exactly the same. Dialectical approaches must also be followed from our perspective, and we need to follow the Socratic method or the method of elenchus always. The dialectic approach and technique was also refined and further developed by GWF Hegel, and then straitjacketed in a material sense by Karl Marx. We may also bear in mind John Rawls doctrine reflective equilibrium here, and this is something we have touched upon in the past. Cross-cultural research design must also be maintained with multiple emic and etic approaches constituting etmic approaches. [30] [31] [32] [33] [34]

➢ *The Preliminary and the bare Essentials of our Approach*

Therefore, as per our approach the following preliminary steps would always apply. The following steps would be reflective of the core essentials of our approach, though there may be some modifications and some deviations from the overall theme: [35] [36] [37] [38] [39] [40] [41] [42]

- Multiple points of view must be obtained, and diverse viewpoints reconciled: Thus the entire pillar of this approach rests on talking to as many people as practically possible, each potentially holding different viewpoints. Literature review must also be accomplished, and primary, secondary, and even tertiary literature perused. Therefore, we need not only good theories, complex theories or composite theories, but also a plethora of different theories that can be evaluated sequentially, and the improbable ones weeded out either through critical examination or scrutiny, or through a trial and error basis.
- Emic, etic, etmic, and dialectical approaches must be made use of. We had discussed emic, etic and etmic approaches in our previous paper, and dialectical

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approaches previously in this paper. The terms emic and etic originated in 1954 with the ideas of the linguist Kenneth Pike, and later extended by anthropologists Ward Goodenough and Marvin Harris. We had further extended these concepts in 2023 to devise many different types of emic and etic perspectives. We had also discussed the concept of cultural frames of reference, and cross-cultural frames of reference previously, and had even extended these to include hypothesis formulation.

- Use of survey techniques, interviewing techniques, questionnaires, brain storming, focus group discussions may be encouraged in the pre-hypotheses stage. Therefore, we encourage a no holds-barred method triangulation in our approach. Likewise, data triangulation and even investor triangulation must be encouraged, though this is by no means a hard and fast rule. Investigators must be non-biased; note our cherished principle of reliabilism. Other techniques such as the five why's techniques, lateral thinking techniques, and out of the box thinking techniques must be encouraged at every stage. Peer review must be performed of the process, as also review by other specialists and subject matter experts. Wherever possible and necessary, subject matter experts – both central and peripheral – should be involved throughout the research process and hypothesis formulation. This is another strong recommendation.
- Data must include spatial data, temporal data and all other forms of data must be used to create a representative and a well-oiled sample. Sample sizes must be appropriate an adequate in relation to the population and sampling frame, and in relation to the confidence level required. In this context, we must reiterate that a statistical hypothesis is one that can be tested using sample data. We have also discussed concepts such as sampling error and non-sampling errors previously, and these concepts would apply as well. Other concepts such as observation, and observation as in statistics will also apply. Data and observations must also be reliable, and there must be no observation bias or no confirmation bias at any stage. All the requisite and essential data must be readily available for the purpose of the study or the investigation, and wherever it is not available, it must be flagged off.
- Admission of multiple causes: We must also admit to multiple causes always, or to a complex combination of causes. A cause is a person, an object or a thing that gives rise to a certain specific action, phenomenon, or a condition. A cause may therefore be wholly animate or inanimate. Therefore, we must seek out multiple causes, and seek out multiple explanations at every stage of an analysis. We must also admit to multiple sets of possibilities, which would from our perspective, be the norm, rather than the exception. We may also perform a cause and effect analysis, which is a fishbone diagram or an Ishikawa diagram methodologically, systematically and in a great level of detail. Parallel investigation into multiple causes must also be carried out at each step of the process. Another related concept is a root cause analysis, and this can also prove to be extremely useful.
- Epistemic coherentism: Hypotheses must also satisfy the principle of epistemic coherentism or epistemological coherentism. We believed this concept was so central and so pivotal to science, that we had even dedicated and entire paper to it. That paper was published towards the end of 2024. All concepts hypotheses included, must be consistent across space and time, and must be ratified by multiple levels of data and multiple data points. We also need multidisciplinarity, transdisciplinarity, and transdisciplinarity, as observed on multiple occasions, and this would be one acid test of data integrity, though by no means the only one. We believe this concept to be as important as conformation holism, if not more.
- Institutional coherentism: We also need institutional coherentism to be adopted and followed. This appears to be one of the biggest Achilles heel in contemporary science given the rampant levels of careerism and self-centric pursuits involved, and this is not easy to set right in a short span of time. Everything will magically set itself in place if researchers understand their duty to science, society and the education system, and play by the rules at all times.
- Non mutual exclusivity: What is meant by mutually exclusive? In simple and in layman's terms, mutually exclusive means that two or more things cannot happen at the same time, or be true at the same time. In other words, the occurrence of one of the events automatically rules out the occurrence of the other event. This is not certainly and absolutely the case here, because a combination of explanations is always possible, and two or more hypotheses may apply in tandem. In some cases however, hypotheses can be mutually exclusive.
- Continuous evaluations of assumptions: What is an assumption in general parlance and in science? Here is an easy and a straightforward definition. An assumption is something that is accepted as true or as certain to happen, without adequate or sufficient (or even any) proof. While some assumptions may be required in any scientific theory or hypothesis, too many assumptions spoil the broth or the party. This is indeed what the principle of Occam's razor states. Also refer to our paper on "Continuous zero-based reassessment of assumptions, hypotheses and methods" published several months ago.
- One or more causes may eventually be proven correct, and the remaining may be castigated or falsified. This is quite natural and obvious, and this is the reason why our process is inherently and innately self-correcting. Hypotheses, or components and constituents of hypotheses that no longer make sense may be buried under the carpet as long as there is no use for them.
- Hypotheses may also be combined or split up as applicable in the interests of better and more robust theorization. Refer to our paper on the sociological ninety ten rule, where we had discussed the concept of exceptionism. Therefore, supplementary hypotheses may be used wherever necessary, or variations to the basic theme adopted to suit awkward or wayward data. We also need to bear in mind the concepts of irreducible simplicity and form versus content or form versus substance at all times. These will stand us in extremely good stead always. We also need integrationism, merger and synthesis, though only as far as practically possible, or necessary.

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- We also need to seek out alternative explanations at every stage. We need a comprehensive evaluation of explanatory power of hypotheses. A hypotheses is said to possess enormous explanatory power if it can solve real world problems convincingly and satisfactorily. It must also fit in with a wide range of data, be compatible with multiple lines of evidence, and must be supported by corroborative evidence. These will naturally lead to multiple lines of enquiry. Likewise, an evaluation of limitations of hypotheses must also be carried out. A probabilistic approach to hypotheses evaluation based on the certainty uncertainty principle for the social sciences must also be carried out and executed wherever necessary. We had written about this extensively previously. The certainty uncertainty principle in physics is also referred to as the Heisenberg principle. We had also published a paper on the certainty uncertainty principle in the social sciences in a paper published in 2022, and had carried forward these principles and concepts multiple times elsewhere. As such, they could prove to be extremely useful.
- Hypotheses will slowly moprh into theories in due course, and a theory is a more refined form of a hypothesis. A law is a theory that has been proven beyond the shadow of any doubt. Alas, the three terms are used loosely and fallaciously even by professional scientists. This is all the more true in the social sciences, and miscategoriations between hypothesis, theories and laws are rampant.
- We may use mathematical concepts such as independent variables, variable initialization, intervening variables, and dependant variables wherever necessary. Independent variables are also called controlled variables, manipulated variables, regressors, explanatory variables, exposure variable, or input variables. Similarly, dependent variables are also called response variables, measured variables, regressands, observed variables, responding variables, etc. We may also use correlational analysis with scatter diagrams, and regression analysis wherever necessary. Other concepts such as Karl Pearson's coefficient of correlation, Edward Spearman's rank correlation method, exponential smoothing, the method of least squares, and the chi square method may also be used, though they may prove to be less useful. We must also bear in mind the fact that correlation does not always imply causation, and the underlying causes must usually be probed into and identified using investigative techniques. In some cases, we may also have unclear causation. In such cases, there may be an uncertainty about the link, difficulty in proving cause and effect, potential multiple causes, etc. In many cases, we may also have probabilistic causation. In such a case, the occurrence of an event only increases the change of something else happening in tandem, but does not guarantee it will occur. Fro example, a new road is planned ten kilometers from town. Will it drive up businesses in the centre of town or not? This is notoriously hard to predict, and probabilistic causation are widely used in fields such as urban dynamics. Therefore, various factors and elements needs to be considered and rather exhaustively so in hypothesis formulation. Factors are an important concept in scientific investigations, and need to be tied to hypotheses and outcomes.
- Qualitative research techniques, quantitative research techniques, and mixed method research techniques may also be employed. We recommend qualitative research for social sciences research such as case study method, though mixed method research can also be adopted. Quantification techniques must be adopted through proper means such as Likert's scale, and Thurstone's scale. Other scaling techniques such as paired comparison scale, rank order scale, constant sum scale, Q-sort scale, and continuous rating scales may also be used.
- This approach may also be combined with investigative techniques such as forensics. We had touched upon these briefly previously, though we would not like to delve into this in depth here. We must also identify and raise red flags from time to time. For example, if the results of two research studies are at variance with each other, it should be a cause for concern. Ideally, this should not be the case. We must also have constructive criticism of other research, and other investigative analyses and reports without malice, bias, prejudice or vendetta. Likewise, if we cannot reach any defintive conclusions, we must have the courage to admit it. If a study of the context is only preliminary, and subject to revisions, the report must clearly say so. Conservatism is prudence; we do not need any fait accompli. Only long-term goals and results matter. Openness and transparency are important hallmarks of our approach. We do not need a large number of rival or competing teams to arrive at reliable conclusions; this would not only be a waste of time and resources, but such a scenario may never come to pass; one well-keeled study should do the trick, and even work wonders. As a matter of fact, aberrations and anomalies will be pushed to the sidelines only if mainstream research is robust and self-contained in every conceivable way. All along the way, we need to make room for special cases and extreme scenarios – one example of this is that actors (airline pilots, for example), acted irrationally, or in bad faith.

➢ *Multiple Independent Hypotheses Model*

We now therefore present the multiple independent hypothesis model. As per this model, and as per this approach, multiple hypotheses must be simultaneously presented, (as a matter of fact, as many as practically possible) and must be simultaneously pursued till the very end. Therefore, an investigation of multiple hypotheses must be carried out in tandem, and hypotheses will naturally fall by the wayside if they do not make the cut. There must be an absolute non-preference on the part of the researcher towards any one hypothesis, and non-bias and non prejudice of any kind. Therefore, there must be absolute neutrality towards all rival or competing hypothesis, and researchers must adopt an absolutely neutral stand. There must be no pet theories or hypothesis. There must be no agendas to push. There must be no axes to grind. Rival hypotheses, competing hypotheses, and alternative hypotheses must also be investigated systematically and thoroughly. The apparent evidence towards one hypothesis does not preclude the possibility of other hypotheses, and the presence of multiple root causes

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must be admitted to. Therefore, there can be complex and composite hypotheses.

Interrelationship between a large number of variables must be admitted to. Multiple independent variables and multiple dependant variables can occur. Complex research design may be required. Terms such as compound and complex and compound are used in many fields such as mathematics, chemistry and English grammar, and should be self-evident to readers. Events may have direct causes, or indirect causes, and these must be duly probed and investigated as well. The causes of events may or may not be so evident, and these must be proposed and investigated as well. For example, the alleged mismanagement of Boeing may be either due to management error or incompetence, or due to financial losses and cost cutting. These are two independent hypotheses, though both may be correct in part. Financial losses are only an indirect cause, though they may have led to cost cutting, and an attendant compromise on quality control.

Likewise, the underlying causes behind the Piltdown man hoax and the Schon scandal may be notoriously hard to pinpoint, though we can make a few educated guesses. Financial constraints, and the fervent desire for recognition could be a few causes. Some amount of fuzzy logic may be involved, a concept which we have discussed in our previous paper. Likewise, the Out of Africa theory in its conventional and orthodox form, ought to have been jettisoned a long time ago, given the fact that it has been long since falsified by multiple lines of evidence – Denisovan man, Peking man, Hathnora man, and Balagonda man to name a few. Sometimes, careerism causes outmoded ideas to linger on, or to stick on. We must fight such tendencies with weapons such as these.

Therefore a complex set of hypotheses and root causes must be admitted to; the evaluation of the positives of each hypothesis must be performed and carried out; the evaluation of the negatives of each hypothesis must be performed or carried out; constant revisions to, or refinement of hypotheses must be performed and carried out at every stage of the research process. There must be no static hypotheses such as the Out of Africa hypothesis, and a great deal of complexity must always be admitted to in research also requiring an analysis of contradictory data or evidence as required- we had labeled this non self-canceling contradictory data or evidence. We had also written about strong data or evidence and weak data or evidence extensively previously. Abandoning unfeasible hypotheses when the time or need for it arises is another critical component of this approach and this technique. Hypotheses may also be suitably recast, and improved upon in due course. Therefore, self-correcting scholarship is required. Therefore, self-adjusting scholarship is required. Some hypotheses may gradually drop off the list as they may be eventually deemed invalid or irrelevant, or simply outdated.

- *Rating of Individual Hypotheses in A List of Possible and Different Hypotheses*

Rating of individual hypotheses in a list of possible and different hypotheses is possible, and can be based on several methods such as the following:

- Schema 1: Very strong, strong, moderate, weak, very weak
- Schema 2: Very likely, likely, moderate possibility, somewhat unlikely, highly unlikely
- Schema3: Rating on a scale of 1 to 10
- Schema 4: Ranking of hypothesis in the order of probability
- Schema 5: Ranking of hypothesis in the order of probability based on a complex set of attributes or factors
- Schema 6: Evaluation of upsides to each individual hypothesis
- Schema 7: Evaluation of downsides to each individual hypothesis
- Schema 8: New evaluation of each individual hypothesis
- Schema 9: Assigning probabilistic weights o individual hypothesis based on the certainty uncertainty principle for the social sciences (Refer our paper on the certainty uncertainty principle for the social sciences and the probabilistic approach to hypothesis evaluation based on the certainty uncertainty principle for the social sciences, both of which were published earlier)
- Schema 10: Assigning probabilistic weights to individual hypotheses by any other means

For example, we had the Air India Kanishka crash of June 23rd 1985, and all other competing or rival hypotheses were ruled out, and it was eventually conclusively established that sabotage was the cause. We also had the Air India 171 crash at Ahmadabad on the 12th of June 2025, and there are multiple theories such as dual engine failure, maintenance issues, pilot error, and other peripheral and fringe theories such as seat slippage. Likewise, we had incidents with Jeju Air, and Air Alaska recently. Therefore, an investigator must investigate several competing hypotheses in parallel, instead of tenaciously clinging on to pet theories, or waiting for other investigators to take up their own pet theories. This would as such, constitute a crucial component of this process. Selection of the most plausible hypothesis in some cases must be resorted to in many cases. Selection criteria must be devised on a case to case basis. What is a criterion? A criteria is a principle or a standard (or a set of criteria or standards) by means of which something may be adjudged, weighed or evaluated. We must therefore, seek out alternative explanations at each stage. There must be a strong emphasis on logic and reasoning, and logical fallacies must be avoided at all costs and under all circumstance. Practical, down to earth approaches must be adopted, and scientism and mumbo jumbo must be eschewed. Simple, practical solutions work the best. We cannot justify nonsense no matter how hard you try; we cannot build anything on an edifice of lies; we must base our research on strong fundamentals. We will then not only succeed, but also never go wrong. These must become

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our lodestar, and the guiding principles of all scientific activity. [35] [36] [37]

➢ *Logic and reasoning*

We must adhere to the highest level of logic and reasoning at every stage in the research process. This would constitute the very basis of this model. Logic is generally defined as the science of reasoning, and is seen as an important branch of philosophy originating in Ancient Greece, China, and India, though logic is generally not seen to be an empirical (i.e., based on experiments or observations) science like physics, chemistry, or biology. Logic is instead seen more as a non-empirical science such as mathematics. It also includes the study of the mental processes involved in reasoning, though this is my no means the only part. In this respect, the study of reasoning overlaps to a great degree with psychology, neurophysiology, or neurobiology. Therefore, logic also encompasses the study of reasoning, the principles of valid inference and argumentation, and offers a platform that can help us distinguish between sound and unsound reasoning and provides a framework for evaluating information and making decisions. Logic is a central and an intrinsic part for critical thinking and problem-solving, and is widely applied in many fields, such as philosophy, mathematics, and computer science.

Logic may be further subdivided into two main branches of logic, namely formal and informal logic. Formal logic refers to the study of deductively valid inferences or logical truths, and it also examines how conclusions are derived from premises based on the structure of arguments alone, regardless of their topic, structure or content. Informal logic on the other hand, is associated with an evaluation of fallacies, the art and science of critical thinking, and argumentation theory. Informal logic examines arguments as expressed in the form of natural language while on the other hand, formal logic makes use of more formal language. Informal logic is also more commonly used in everyday, informal situations, as opposed to formal logic, which is used in more formal contexts and situations. Logic also involves a study of arguments, which consist of a set of premises that leads to a conclusion. Premises and conclusions may therefore express propositions or claims that can be true or false. The study of logic also involves logical operators such as Boolean variables, and AND, IF, OR, or NOT statements, Another related concept is empiricism; this doctrine, as developed by John Locke, George Berkeley, and David Hume, holds that all knowledge and all knowledge forms are primarily derived from the senses. Rationalism on the other hand, involves basing opinions and actions on the basis of reasoning and sound argumentation. This philosophy is attributed to Rene Descartes and Baruch Spinoza. [38] [39]

We also have concepts such as logical constant which holds the same value throughout the problem. Logical operators may include monadic operators – only one argument, - Dyadic operators, - two arguments, - and binary operators, - symbols that represent operations that are performed on two operands or values. We also have different types of logic such as inductive logic and deductive logic, and also inductive arguments, inductive inferences, deductive arguments, and deductive inferences. The major difference between the two is that premises of deductive arguments provide sufficient evidence or data for arriving at the conclusion, while on the other hand, premises of inductive arguments provide some evidence for the conclusion. Another difference is that while deductive logic commences with general principles and then moves towards specific conclusions, inductive logic commences with specific observations and ten moves towards broader generalizations.

Ampliative logic unlike deductive logic, refers to reasoning that goes well beyond the information contained in the premises, thereby resulting in new and novel conclusions, and adding new information, and enlarging or extending knowledge. Syllogistic reasoning is a form of deductive reasoning that uses syllogisms. A syllogism is a type of logical argument that consists of two premises, namely a major premise and a minor premise, that lead to a definitive conclusion which necessarily follows from the premises.

We also then have logical sequitors, a conclusion that follows logically from the premises, and logical non-sequitors, where the conclusion does not logically follow from the premise. Logical non-sequitors are anathema to our approach, and must not be tolerated under any circumstances. In the field of logic, a proof is a demonstration that a particular statement (also known as a conclusion) is necessarily true, given a set of premises or assumptions. Proof may be direct proof or indirect proof; it may be definitive or non-definitive; we also then have the concept of deductive proof which is a logical argument that uses well-established and amply proven facts, definitions, and theorems to demonstrate the truth of a specific statement. We may also make use of rules of inference that are logical guidelines used to derive conclusions from given set of premises. In every form of reasoning, we must stand vigil against formal and informal fallacies, which we had examined critically and extensively in some of our previous papers. Needless to say, these can take on multiple and myriad forms.

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[39] Gottfried Wilhelm Leibniz, 1704, *New Essays on Human Understanding*, Preface, p. 153.

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Statements must be defined clearly and logically, and entirely in unambiguous terms. Propositions are widely used in propositional logic, which is a branch of logic that investigates relationships between propositions. Types of propositions include simple propositions, compound propositions, relational propositions, disjunctive propositions, conditional propositions, etc. Arguments must also be sound. In logic, an argument is a series of statements, whereby the premises are offered as reasons to support the conclusion. Arguments may be either valid or invalid, depending on whether the conclusion follows logically from the premises or not. We also have deductive arguments and inductive arguments, the former being more conclusive and the latter being less conclusive. An inference is a conclusion arrived at on the basis of reasoning. We may likewise have valid inferences, invalid inferences, inductive inferences, and deductive inferences, and all the terms are self-explanatory. Scientific induction may also be used, and this is a method of reasoning wherein general rules or principles are developed based on a large number of sequential observations. We also have always argued in favour of the inductive approach, though this must be subject to time and cost concerns and considerations. Enumeration is used to systematically list items of evidence, and inference may also be drawn from analogy, which is a similar or a related example.

In science, an axiom is a statement or proposition that is considered to be widely established, widely accepted, or obviously true, while a postulate is a thing suggested or assumed as true as the basis for reasoning, discussion, or belief. Sound axioms and postulates may be used as the basis of reasoning. Hypotheses may be used to build more complex paradigms and frameworks, and hypotheses must be provable, demonstrable, and generalizable. There are definite limits to knowledge, and researchers must know what is knowable, and what is unknowable. Counterexamples and contradictions may also be actively sought out, and we may employ the minimal counterexample principle, and also use counterexamples to demonstrate the validity of a proposition. All these concepts can naturally be made use of in the process of hypothesis-building.

II. CONCLUSION

The main objective of this paper had been to present the 360 degree approach to hypothesis formulation and evaluation. The main reason why we had presented this approach is because we believed that existing approaches were somewhat, if not woefully inadequate, and because scientific method may itself be somewhat in need of an overhaul as its core constituents are somewhat ageing, and not entirely in tune with today's highly and tightly interconnected world. We began this paper by defining research, research design, and by reviewing already existing approaches to hypothesis building and formulation. The core essentials and the barebones of our approach were also then detailed, along with some of our supplementary proposals. Therefore, the multiple independent hypothesis model was presented as a part of this paper along with its core concepts and hypothesis evaluation mechanisms. This was also additionally achieved and accomplished by means of a few suitable illustrative examples which we believed were inherently interesting. Lastly, the core concepts of logic were explored along with their bearing on the concepts and core essentials of this paper. We do hope, expect and anticipate that this paper will become a core and an intrinsic component of twenty-first century science. As it has been rightfully pointed out, the proof of the pudding is in the eating. Therefore, the acid test of this paper will always be whether it leads to intrinsically better and superior results or not. We will patiently wait for this assertion to be ratified.