

**Epistemological Contrasts
between
Science & Social Science**

Newtonian Construct of Epistemological Contrasts between Science and Non-Science

- The first major Newtonian construct of epistemological contrasts between Science and Non-Science is the contrast between 'exact' and Social is 'inexact'. All Sciences like Physics, Chemistry, Geology and Biology were called 'exact' and all Non-Sciences, 'inexact'.
- The next contrast in the construct was between 'certain' and 'uncertain'
- The third contrast was between 'linear' and 'non-linear'
- The fourth contrast was between 'stable' and 'unstable'
- The fifth contrast was between 'predictable' and 'unpredictable'
- The sixth contrast was between 'objectivity' and 'subjectivity'
- The seventh contrast was between 'scientific' and 'unscientific'. Newton reality could only be grounded in knowledge obtained from observables. Any departure from this rule was considered unscientific.
- The epistemological reason for the contrasts was the capability of science to discover fundamental laws and produce mathematical proofs.

Positivist Epistemological Construct of Contrasts between Science & Social Science

- Social Science deals with Complex and irreducible Social Objects
- Science deals with relatively simple and reducible physical Objects
- Social Science has to handle interrelated phenomena with too many variables to be amenable to establish any causal sequence
- Science handles independent phenomena with limited variables amenable to establishing causal links and sequence
- Social Science has to deal with subtleties of Human Affairs and uniqueness of Social Processes hardly amenable to scientific investigation
- Science deals with physical objects of obvious properties, which can be scientifically tested and experimented with
- Social Science has to deal with social behaviours that differ in time and space defying generalisations
- Science deals with movement of physical objects, which follows definite laws enabling inductive generalisations
- Knowledge of social phenomena itself is a social variable and human subjects of experimentation behave unpredictably
- Knowledge of scientific phenomena does not affect scientific phenomena and physical movements are predictable

Einsteinian Re-inforcement of Newtonian Science

- For Einstein Science is material science, an instrument by means of which scientists are able to obtain systematic deductively formulated empirically verified concepts of reality.
- This instrument works in two different worlds: 1. The empirical world where objects of observation exist and observation takes place. (Particular) 2. The mathematical world, where the scientist postulates mathematical constructs as representations of the empirical world. (Universal)
- Einstein says: “I am convinced that we can discover by means of purely mathematical constructions the concepts and laws connecting them with each other, which furnish the key to the understanding of natural phenomena.”
- Einstein’s empiricism is the empiricism of mathematical construction, which is so devised that it connects observational data to theoretical objects with mathematical axioms.
- Einstein refused the notion that knowledge is based on empirical givens. He believed that the truly creative principle of theoretical physics is the formulation of mathematical constructs enabling theorisation.
- For Einstein the rationalistic mathematical constructs come first, it is only much later after deductively formulated conclusions are drawn from the mathematical theory, that these conclusions are checked against empirical evidence.
- Many of Einstein’s mathematical theories were verified later by other physicists after devising appropriate experiments.
- Einstein’s laboratory was the abstract setting of his mathematical theories. He argued that axiomatic bases cannot be abstracted from experience, but must be freely and independently invented amidst mathematical axioms, postulates, hypotheses, theorems and proofs.

Einsteinian Epistemological Construct of Contrasts

- Einsteinian scientific epistemology divided sciences into Material Sciences (Physics, Chemistry and Geology), Bio-Sciences and Social Sciences – Material sciences dealing with objects of closed systems devoid of biological and behavioural properties, and Biological and Social Sciences dealing with purposeful, goal seeking and affectively responding objects
- In Einsteinian epistemology Bio-sciences though pertain to behavioural aspects were closer to Material Sciences because of their scientific research methods i.e., the methods of material sciences
- However, Einsteinian epistemology distinguished material sciences from bio-sciences showing that Objects of material sciences can be broken into pieces without losing its characteristics and the properties of the mass and pieces are the same, whereas, Objects of bio-and social sciences are wholes and parts without mutual representational power and the two cannot be separated without losing their identifying characteristics. They are irreducible objects
- In Einsteinian epistemology the fundamental contrast between sciences and social sciences is that of the objectivity \gg subjectivity dichotomy

Einsteinian Objectivity >< Subjectivity Dichotomy

- Knowledge is objective if it is independent of the person who produced it, the time and place. Scientific knowledge is objective in this sense
- Knowledge is subjective if it belongs to the perceiving self. Social scientific knowledge is subjective in this sense
- It is the effort to keep the self separate and independent from the observation, which is called objective in social science. In the Einsteinian sense, this is a dubious extension of the concept of scientific objectivity
- According to Einstein objectification and objectivity are obtained by exercise of reason. To him objectification consists of inventing mathematical equations whose objects are mathematical entities. The senses and perception do not intervene until observational data become objects of theoretical statements.
- To Einstein mathematical postulates → theorems → empirical data is the direction or process of objective knowledge production
- From empirical logic → postulates of deductively formulated theory is a direction or process of subjective knowledge production to him

Post-Einsteinian Epistemological Shift of Science from Certainty to Uncertainty

- An Epistemological shift from Science to New Science began with Max Planck, whose Quantum physics approved the dual interpretations of the world: 'the wave interpretation' and 'the particle interpretation' – as two equivalent systems of observable events.
- In Newtonian physics, the motion of a particle is completely determined if its 'position' and 'velocity' at a certain time are known. This rendered the fundamental laws thesis and calculation of the future possible.
- Quantum physics shattered this certainty and predictability by proving that both 'position' and 'velocity' cannot be measured at the same time with same accuracy. The accuracy with which one of the variables, 'position', is measured, depends on the value of the other variable, 'velocity'.
- In Quantum physics or particle physics as it is not possible to know the present position and present velocity of an electron with absolute precision, there is only probability of one in a range of probabilities, and hence calculation of the future not possible.

Epistemological Status of Post-Einsteinian Science

- Post-Einsteinian scientific epistemology following Max Plank and Schrodinger, put scientific knowledge tentative by replacing the basis of fundamental laws with the basis of statistical links between causes and effects
- Heisenberg's Principle of Uncertainty turned scientific knowledge with 'no theory of certainty'
- Bohr's Complementarity Principle and Godel's thesis of 'Undecidability' made scientific knowledge further uncertain and tentative
- Feynman pointing to modern physics deprived of its system of laws that could unambiguously bind effects and causes, acknowledged imprecision as an inevitable aspect of scientific communication.
- With Heisenberg, Bohr, Godel and Feynman scientists began to wrestle with 'uncertainty' and 'imprecision' about the known and 'unknowability' about the unknown.
- Heisenberg confirming the relationship between the measurer and the measurement showed that the action of measuring affects the accuracy of the measurement. Schrodinger through genial manipulation of mathematical equations applied to atomic and subatomic phenomena in Physics concluded object-subject split a figment of the imagination.
- This demolished the foundation of scientific objectivity based on the claim of its disassociation between the observer and the observed.
- Post-Einsteinian scientific epistemology thus dropped scientific knowledge from the heights of finality to uncertainty, imprecision, non-linearity, instability and unpredictability

Constitution of New Science

- Gellmann's concept of Effective Complexity (EC) offered a framework for the definition and constitution of New Science.
- Effective Complexity is measured on the basis of the length of the message required to describe properties of a certain system. The message must encompass description of two kinds of properties: 1. *Regularities* i.e. description by which compressible features of the system are encoded; and 2. *Randomnes*, i.e., description by which the incompressible random elements are captured
- The EC of theories which encompass general properties of the universe in a few equations, is the lowest. The EC of theories which encompass particular properties of a genotype's string in a long description is large
- Like August Comte, Gellmann builds a hierarchy of sciences in terms of the degree of EC. Particle physics, the most fundamental science in terms of which all other sciences can be derived or expressed, is on top with lowest EC. A simple equation can represent and comprehend the whole complexity of the world of micro-particles.
- Chemistry, biology, biochemistry etc in the ascending order of EC fall next in the hierarchy
- As the complexity of the system increases, our ability to make precise statements about its properties diminishes.

Constructivist Epistemology of New Science

- A group of theoreticians emerged in England and France in the wake of the collapse of the foundation absolute science which came to be called Constructivists. English Constructivists were G. Bateson, H. Simon, von Foerster, von Glasersfeld and Rorty. French Constructivists were J. Piaget, E. Morin, P. Valery and Le Moigne
- Constructivists oppose the dogma of objective truth solely based on reason. They maintain that knowledge of the world cannot be acquired by reason alone. To them the act of knowing is also the result of experience-based activities which can only be achieved by a subject. Knowledge is constructed through acts of cognition, such as representation, imagination, understanding, intuition and so on. Experience is characterised by the following principles: Irreversibility, The dialectical aspect of the cognitive act' Recursivity, Uncertainty, and an overt refusal of an objective truth.
- Von Foerster said, "Objectivity is the delusion that observations could be made without an observer." "What we call knowledge cannot be a picture or representation of a reality that has not undergone the transformation of being experienced ----it is the subject that actively constructs what it perceives."
- Moigne said that new knowledge is constructed or built in the very act of developing it. Quoting the poet Machado he remarked: 'The path does not exist. It is opened as we walk.'
- Piaget pointed out the inseparability between the act of knowing an object and the knowing subject's act of knowing itself. It is through the interaction of the two that the action of knowing organises the world while it organises itself.
- The new sciences produce their own epistemological foundations in the act of producing new knowledge. In this sense new sciences are autonomous sciences and constitute sciences of autonomy which can develop themselves in the process of being developed.

Constitution of the New Social Science

- Following the new developments in science depriving social science of their epistemological foundation, Comtean positivist social science underwent the process of reconstitution as New Social Science as a shadow of New Science, by adopting Constructivism as its epistemological foundation
- A inevitable logical course because Constructivism was the alternative emerged opposing and replacing both the old positivist and neo-positivist approaches based on realism and determinism of quasi-laws adapted from physical sciences
- Constructivists claim that the old methods of reasoning, which were used to treat complex systems and complex problems with scientific approaches derived from positivistic and analytical sciences, must be revised to find new epistemological approaches better adapted to the social sciences.
- Constructivist epistemology helped Constitution of the New Social Science by countering the indictment that social sciences are soft sciences and they lack epistemological and methodological status and are less scientific, rigorous, or valid than material sciences was quite contextual and timely
- Constructivist Epistemology helped New Social Science to accept itself as science of complexity and absorb a series of new areas of knowledge such as sciences of the artificial, sciences of design, sciences of information and decisions etc., as sciences of complexity

Constructivist New Social Science

- Constructivist New Social Science (CNSS) does not tolerate the neo-positivist tool-kit approach of dealing with complexity by adapting the methodology of physical sciences, which can produce only meagre results.
- CNSS introduces irreversibility, teleology (purposefulness), morphogenesis, cognitive capacity, memorisation, auto-referencing, strategy, intelligence etc., which until recently were ignored. It asserts that complexity must be conceived cognitively and intentionally without reducing it or mutilating it. (Le Moigne).
- It is not clear whether Gellmann's effective complexity principle can be related in any way to Constructivists' overarching concept of complexity.
- As delineated by D' Agostino, CNSS has the following Features:
 1. Reflexivity (Social scientists depend on other subjects for their understanding social reality),
 2. Contestability (as based on value judgements and are evaluative),
 3. Evaluation and Projection (purposeful with ethical obligation).
 4. Added capacity to accommodate new sciences such as management, information sciences and cognitive sciences with the constructivist perception of creative and projective intelligence concepts.
 5. Recognition of sciences of the artificial and its physical symbol processing system hypothesis that help constructivists assert that 'our understanding and availability of the basic symbolic system manipulating processes of computers provides the necessary and sufficient conditions for an artificial system to exhibit and to be endowed with intelligence. Postulation of sciences of artificial that demonstrates the importance of meta-cognition and creativity, and acquires meaning of the meta-systemic properties of higher epistemological levels.

Constructivist Standards of Scientificity

- Piaget and G. Bachelard proposed a solid and well-argued framework for the validation of the sciences of complexity.
- How to validate the scientificity of Artificial Intelligence What is this intelligence which is capable of computing symbols, and what is this symbol which can be computed by an intelligence ?
- How to establish the scientificity of the concept of 'computation of the mind, which views computation as a physical system that can be governed by representation and cognition synonymous with computation ?
- We need new standards of scientificity for the cognitive sciences, computation sciences, communications sciences, decisions sciences and information sciences, and artificial intelligence that are linked by the overarching constructivist paradigm. (von Foerster)