

# Research Areas

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## 1 General Research Areas

Logic (Formal and Philosophical Logic), General philosophy of Science, Formal Epistemology

## 2 Description of Specific Research Areas:

The broader research interests involve, general approaches for belief revision, role of abduction in belief revision, epistemic analysis of causality, Logic of Counterfactuals, and understanding Scientific theory change in the history and philosophy of science. The major goal of my research is contribute to the development of formal models of belief revision, which comes closer to the human intuitive belief revision. Some of the main research interests lie in:

- **Causal approach to Belief Revision:** Causality and Belief Revision as major research areas are widely explored, mostly independently, in Philosophy and Artificial Intelligence, respectively. Despite the fact that causality plays a crucial role in revision of beliefs and models of belief revision makes the causal learning effective, there has not been much work done in this direction. Moreover the limitations of existing formal models of belief revision which are mostly idealized and mostly suitable for the non causal environment. Hence, the current work involves finding missing links between causality and belief revision and develop formal models of belief revision which not only respect logical consistency but also the causal consistency. The work also involves understanding how causal models influence human belief revision process.
- **Belief Revision based on Abductive Reasoning** Abduction is a typical research theme where especially logic and philosophy of science meet today. Many reasoning conclusions that do not proceed in a deductive manner are called abductive. For instance, if we see a broken horizontal glass on the floor we might explain this fact by postulating the effect of wind shortly before. In simple terms, Abduction is viewed as the process of forming an explanatory hypothesis. It is the only logical operation which introduces any new idea, which is missing in deduction. Most of the formal models of belief revision are based on deduction, and are based on the principle of logical closure. Many belief revision situations goes beyond deduction. The work involves connecting abduction and belief revision and show how abduction as a reasoning process and and generation of best explanations, guides us in the belief revision process.
- **Epistemic Analysis of causation:**

Broadly speaking, Causality refers to the relationship between events (objects, properties, facts, mechanisms, processes) where one set of events (the effects) is a direct consequence

of another set of events (the causes). However, Causal inference is the process by which one can analyze data to make claims about causal relationships and make it distinct from mere correlations. Since inferring causal relationships is one of the central tasks of science, it is a topic that has been fiercely debated in philosophy, statistics, and the other scientific disciplines. In philosophy, the major starting point has been the regularity view of causation, according to which, causality could only be adequately defined in terms of empirical regularities, involving classes of events. Other non-received views include approaches based on causal powers, causal process and mechanisms. Each of the approaches have its own limitations. The present study involves comparison of two prominent approaches, one due to Pearl (Structural model) and Wolfgang Spohn (based on Ranking functions). We bring out relative merits and demerits of each of these approaches in dealing with the probabilistic and deterministic causation.

- **Role of Abductive reasoning in Scientific discovery**

Traditionally, creativity and discovery in science are seen as a mysterious irrational process. The development of human society has now reached a technological level in which issues concerning the creation and the dynamics of information are absolutely crucial. In Sciences, inductive and hypothetico-deductive methods are commonly regarded as the two main theories of scientific method. The former method focuses on the discovery of empirical generalizations, whereas the latter is used to test hypotheses and theories in terms of their predictive success. Despite its wide usage in the social and natural sciences methodology, the standard inductive and hypo-theoretic-deductive views of scientific method provides little attention to the process of theory development or generation of a hypothesis. On the other hand, Abductive Reasoning includes discovering new hypotheses or explanations. The present work seeks to emphasize on the significance of abduction in the scientific discovery. We consider two case studies, one from the astronomy( Kepler's discovery that the Martian orbit is ellipse) and the other from the modern science. We argue that true innovation (discovery) need not be restricted to the studies of previous successes (induction).

### 3 Some Important References

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2. Pearl, J.(2000). Causality. Models, Reasoning, and Inference. Cambridge: Cambridge University Press
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