

Belief Revision: Achievements and Challenges

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More than three decades ago, a new research area was born at the crossroads of Formal Philosophy, Cognitive Science, and Artificial Intelligence. This area is now known as *Belief Revision*. It studies the process by which a rational agent changes her beliefs in the light of new information. For example, suppose that Margarita, an archaeologist, discovers ancient Greek coins during the excavation of an ancient tomb in Japan. This will change Margarita's beliefs on ancient trade routes and ancient Japan's seafaring technology, or even on the wider impact of classical Greece to the Far East. On the other hand, the discovery is not likely to have any effect on Margarita's views on social benefits or on combat-sports. Such belief change scenarios (albeit not as dramatic) are common when an intelligent agent is interacting with her environment. Belief revision is a central cognitive capability, and thus its modelling is important in a number of disciplines. What makes the modelling problem non-trivial is that, in principle, it is not enough to simply add the new information to one's stock of beliefs; some of the old beliefs need to be withdrawn on pain of inconsistency. Furthermore, there is typically more than one choice on which beliefs to give up.

The most influential attempt to model the belief revision process appeared in the early 1980's and is based on formal logic. In particular, beliefs are represented as logical sentences, and the process of belief revision is modelled as a function $*$ that maps a set of beliefs K (representing the agent's initial beliefs), and a sentence ϕ (representing the new information), to a new set of beliefs $K * \phi$. To capture the notion of *rational* belief change, a number of postulates were introduced by Alchourrón, Gärdenfors, and Makinson that regulate the revision function $*$; these postulates are now known as the *AGM postulates* for revision. It should be noted that AGM postulates define, not one, but a whole class of revision functions $*$, intuitively corresponding to different revision policies employed by different rational agents. In addition to the above axiomatic approach to Belief Revision, a number of *constructive models* have been proposed. Moreover important theorems (known as *representation results*) have been established that prove the equivalence of the axiomatic and constructive approaches.

In this talk we shall journey through the main models and results in Belief Revision. We shall also discuss the challenges that lie ahead, focusing mainly on *iterated revision* and *relevance*. Both are aspects of the revision process that have been left unattended by the AGM postulates. For iterated revision, one would like to capture the intuition that an agent's policy should, in a sense, be consistent thought-out a sequence of revisions. Likewise for relevance, we would like to formally encode the intuition that when revising a belief set K by new information ϕ , only the part of K that is *relevant* to ϕ may change; everything else should stay the same. We shall discuss recent progress on both these issues.