UC Merced

Proceedings of the Annual Meeting of the Cognitive Science Society

Title

Fuzzy Logic vs Pre-Logic: Zadeh vs Levy-Bruhl

Permalink

https://escholarship.org/uc/item/3tz352c7

Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 18(0)

Authors

Maiers, Jerald E.
Maiers, Martin J.

Publication Date

1996

Peer reviewed

Fuzzy Logic vs Pre-Logic: Zadeh vs Lévy-Bruhl

Jerald E. Maiers* and Martin J. Maiers **
*Medical Support Services, 1100 Commerce Drive, Racine, WI 53406
**Advanced Biosciences Computing Center, University of Minnesota, St. Paul, MN 55108
(maiers@execpc.com)

Introduction

In 1965 Lofti Zadeh introduced an innovative engineering notion, fuzzy set theory. Zadeh's approach was essentially rejected by the main stream engineering communities of Europe and America. For 25 years, there were only a small set of western fuzzy logic researchers. But in the late 80's fuzzy set theory reached Japan and China where it produced a fury of activity, including heavy government funding of research and a resultant large industry of fuzzy products. There have been "cultural theories" offered for the vivid difference in the response to this mathematical theory, but there is an underlying explanation lies in the work of an early Cognitive Scientist.

Zadeh - Fuzzy Logic

Zadeh's outlined a radical new approach to mathematics and, by extension, to logic. Classical or crisp set theory is based on the concept that an element is either a member of a set or it is not. In classic set theory there might be a set of persons six feet tall or over. Each individual is either in that set or not. Fuzzy set theory is based on the concept that and element has a degree of membership in a set. In this approach an element is a member of a set to some degree; but an element is also not a member of the set to some degree. In fuzzy set theory there might be a set of tall persons. On the 0 to 1 membership scale Zadeh devised a person six feet tall might be a member to a .8 degree.

Since set theory is fundamental to mathematics, a change from crisp sets to fuzzy sets, implied a reformulation of mathematics. In a similar way, fuzzy premises implied a reformulation of logic. The notion of an element having both membership and non-membership leads to a fuzzy logic that does not support a principle of contradiction.

Levy-Bruhl - Pre-logic

In 1910 Lucian Lévy-Bruhl laid the foundation for the field of Cognitive Anthropology in How Natives Think with his description of the pre-logic nature of non-western thought. This book along with his four others on the same topic focused on modelling the mental functions of non-Europeans based on ethnographic studies.

Lévy-Bruhl's set out to present "the most general laws particular to the mentality of primitives. (1985, p14)." The most general law he identified was the "law of participation." which he describes by saying "in the collective representations of primitive mentality, objects, beings, phenomena can be ... both themselves and something other than themselves (1985, p76)." An example Lévy-Bruhl offers is that a person can be both a human and a bird at the same time.

Lévy-Bruhl contrasts the abstract nature of categories that are used in western versus non-western thought: "The condition of our abstraction is the logical homogeneity of the concepts which permits of their combinations. Now this homogeneity is closely bound up with the homogeneous representations of space. If the pre-logical mind, on the contrary, imagines the various regions in space as differing in quality, abstractions as we usually conceive of it becomes very difficult to such a mind (1985, p121)."

Lévy-Bruhl describes the absence of the principle of contradiction as a major contrast between pre-logic and western logic. He says, "the opposition between the one and the many, the same and another, and so forth does not impose upon this mentality the necessity of affirming one of the terms if the other be denied or visa versa (1985, p77)" He goes on to say, "It is not antilogical; it is not alogical either. By designating it 'prelogical' I merely wish to state that it does not bind itself down to contradiction (1985, p78)."

Contrast of Fuzzy Logic and Pre-Logic

Lévy-Bruhl contrasted the western " logical homogeneity of the concepts" with the non-western pre-logical concepts based on "the various regions in space as differing in quality." Like Zadeh's fuzzy concepts, Lévy-Bruhl's pre-logic concepts involve some degree of membership and non-membership. And just as there is no principle of contradiction possible in fuzzy logic, Lévy-Bruhl identified the lack of contradiction as one of its most significant characteristics of "native" pre-logic.

The pre-logic which Lévy-Bruhl found characterizing non-western thought, is homologous to Zadeh's fuzzy logic.

This analysis suggests a cognitive science hypothesis for the differential response to fuzzy logic in that the contemporary engineers of the Pacific Rim were more pre-logical than their western counterparts. Empirical research would be required to actually test this notion.

In his conclusion Lévy-Bruhl's insightfully suggested that all humans share a mentality that "is both logical and pre-logical." It would seem, in view of the practical implications of the initial rejection of fuzzy logic by western engineering, that this question could be of general interest to Cognitive Science.

Levy-Bruhl, L, 1985, *How Natives Think*, Princeton University Press, NJ.

Zadeh, L., 1965, "Fuzzy sets," *Information and Control*, 8:338-353.