The Link between Mental Representation and Diagram

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Abstract

Diagrams are uniquely powerful tools of communication. Diagrams or pictures are the oldest medium of human communication. They are used for representation as well as for certain types of reasoning. Representation is contained in our thought. Thought has evolved through ages. It is generally believed that thought functions through language. However, there is no natural language in the brain but just the activities of the neurons. Nevertheless language provides a compelling analogy for thought. Another way of characterizing thought is by considering all kinds of ideas and relations among them. The internal linguistic and imagistic reasoning are not the same as their external manifestation. External manifestations of imagistic thought include maps, charts, diagrams and even gestures (Tverski, 2005). Cave painting, petroglyphs, weaving, wood and stone curving, and stelae bear are witness to various roles of representation that serve humanity in under religious, historical, political, expressive, informative, artistic, playful, creative or inferential context No one can deny the influence of pictorial mode of information in the field of advertisement covering a vast field from food item to secured livelihood. This powerful media can address the entire population irrespective of any sophistication.

Chandrasekharan et al [1995] draw an important distinction between two types of representation, internal representation and external diagrammatic representation. External diagrammatic representations are constructed by the agent in a medium in the external world (paper etc.). Internal diagrams or images comprise the internal representations that are posited to have some pictorial properties.

The logicians focus on external diagrammatic systems, the imagery debate among philosophers of mind and cognitive scientists is mainly about internal diagrams; research on cognitive role of diagrams touches on both forms.

Researchers working on multi-model reasoning challenged the prejudice against diagrammatic representation. Their approach can be broadly categorized into three distinct groups. One branch of research can be found in philosophy of mind and cognitive science. They have explored human reasoning and mental representation involving non-linguistic forms. Another group of researchers working on diagrammatic reasoning shows that there is no intrinsic difference between symbolic and diagrammatic systems as far as their logical status is concerned. Some logicians have proved that diagrammatic systems can be sound and complete in same sense as a symbolic system. The third direction in multi-model reasoning has been taken by computer scientists with a practical aim in view. For example, knowledge representation, system design, visual programming, etc. found new and exciting opportunities in this new concept of heterogeneous system and have implemented diagrammatic representations in their areas of research.

According to Herbert Simon the role of reasoning in language and diagram is different. The irrationals for example, found no place among the integers or fractions, they were essential for representing the lengths of lines in geometric diagrams. Say for instance, the ratio of the diagonal to the side of the square and of the circumference to the diameter of the circle. It has been suggested that this ability of diagrams to represent irrationals that could not be handled by arithmetic was the sole motivation of Euclid to develop his scheme of geometric reasoning. Linguistic(algebraic) and diagrammatic representations found common ground during Descartes invention of analytic geometry. With the legitimation of the irrational numbers in the 19th century by Dedekind, symbolic mathematics posed a threat to vanishing geometric diagrams. As a matter of fact, certain paradoxes could be derived from clever/carelessly constructed diagrams; the use of diagrams in carrying out proofs became increasingly unfashionable, though natural language was not free from this charge either.

The dominance of sentential representation system in the history of modern logic has obscured several important facts about diagrammatic system. Euler circles, Venn diagrams, and Lewis Carrolls squares were used as heuristic tools. It is important to mention that C.S.Peirce revised Venn diagram to make it more expressive and also invented a graphical system called Existential graphs which has been proved to be equivalent to predicate logic. These existing diagrammatic representation systems have inspired a group of researchers who have drawn our attention to the subject in two distinct ways. First, their interest has centered round the externally drawn representation system as opposed to internally drawn mental representations. Second their aim has been to establish the logical status of a system, by

testing the correctness and the expressive power of selective representation system.

There are two goals in the research of diagrammatic reasoning. The first is to deepen our understanding of ourselves and the ways in which we think. The second goal is to provide an essential scientific base for constructing representations of different diagrammatic information that can be stored and processed by the computer. This leads the computer to achieving computational efficiency in the similar manner in which now diagrams provide to human beings.

It has been claimed that a picture is worth a thousand words. This is well supported by empirical evidence, suggesting that diagrams and other information graphics can enhance human cognitive capacities in different contexts. Chabris and Kosslyn argue that the best diagrams depict information the same way that our internal mental representation do. The Representational Correspondence Principle of Kosslyn suggests that diagrams in order to be effective, should depict information in the same way that our internal mental representation does.

Diagrams facilitate learning. Learning of alphabet is initiated through geometric shapes. Flow charts, Venn diagram, tree diagram are to cite a few more examples. A mental image is an internal representation that produces the experience of perception in the absence of the appropriate sensory input. In this sense, imagery is a perceptual representation stored in short term memory. Imagery is popularly believed to be involved in visual-spatial reasoning. Corresponding to each mode of perception there are different kinds of imagery. It is due to recent interaction among philosophers, logicians, cognitive scientists and computer scientists to focus on different types of representation systems that brought forth diagrammatic representation system as a study of research.