

## COGNITIVE SIMULATION : SOME PHILOSOPHICAL OBSERVATIONS

### ABSTRACT

The study of 'Cognitive Simulation' as a part of decision theory has, over the past two decades, been gaining increasing importance. The basic discipline which provides sustenance to research in this field is psychology. However, philosophy can contribute significantly in understanding some of the problems which the researcher faces in establishing the link between cognition and decision making, especially those related to the understanding of the role which memory plays in the cognition process. This paper attempts at identifying some philosophical concepts, exploitation of which can prove useful in a better comprehension of the above linkage.

### 1. Introduction :

Over the past four decades, ever since Von Neuman and Morgenstein propounded their theory of games, the area of studies under the umbrella of what has come to be termed 'Decision Analysis', has been steadily expanding. By decision analysis, I mean "the techniques and principles of problem solving variously referred to as policy science, Benefit cost analysis, Operations research, Systems analysis and Decision theory".<sup>(1)</sup>

In this paper I restrict myself to the Decision theory component of Decision analysis. The area which decision theory has as its legitimate field of enquiry, can be classified into two components (i) understanding the 'process' of decision making, and (ii) postulating assumptions under which men make decisions, and then carrying out normative studies by using the tools of say, statistics or game theory, in order to predict decision making patterns.

To give an example of the former, we have the enormous body of work which speculates on the decision making process in human beings, by simulating chess playing on the computer, or better still, the vast amount of experiments being conducted in laboratories by behavioural scientists. Examples of the latter are easily provided by the work being done in the field of wel-

fare economics which assumes rationality in human being ( for instance, behind indifference curves and pareto optimality ).

While great strides have been made in developing a theory for the exposition of the second component of decision theory not so much has been achieved to convincingly explain the 'process' of decision making. This was perhaps to be expected, since the second component relies heavily on quantitative formulations, once the basic assumptions have been agreed upon ( perhaps too smugly ! ); while the first component relies heavily on psychology not yet an exact science ( notwithstanding whatever its practitioners may claim ).

## 2. Cognitive Simulation :

As the need for more research to understand human thought processes becomes increasingly important, the impetus being provided by demands made either by professional administrators ( clamouring for 'exact' theories of motivation ), or by people engaged in education dissemination of information ( clamouring for theories which can explain the comprehension process in human beings ). Researchers in their attempts to understand the human thought processes better, are naturally relying increasingly upon cognitive psychology to provide them with answers. In the discipline of cognitive psychology, notable contributions are being made in the field of cognitive simulation. Herbert Simon in describing this field states, "There has been a parallel ( to operation research, artificial intelligence and computational complexity ) development in the past two decades of a positive theory of procedural rationality in the discipline of cognitive psychology based primarily on work that uses the computer to simulate human thought processes".<sup>(2)</sup> One of the chief areas of research in cognitive simulation is concerned with understanding the characteristics of short term memory ( STM ) and long term memory ( LTM ). The relevant attributes of STM and LTM, engaging the attention of researchers, is explicitly stated by Simon :

- ( a ) Information that is being processed by the human Central nervous system has to be held in STM, a memory of notoriously small capacity".<sup>(3)</sup>

- ( b ) "Research in recent years has shown that human performance on cognitive tasks is dramatically sensitive to the limits of STM, for example, in concept attainment tasks when a generalization is to be derived from a sequence of instances, only a few of the most recent instances can be held in memory, with the result that hypotheses are often entertained that contradict evidence that was available only a few minutes earlier".<sup>(4)</sup>
- ( c ) "Clearly the use of Selective heuristics, a characteristic of many artificial intelligence programmes, is even more highly developed in human thinking. The study of skilled chess players shows that a body of knowledge stored in longterm memory ( LTM ) compensates in large measure for the slowness of search. The human expert does not so much 'Search out' the correct move as 'recognize' it."<sup>(5)</sup>

Research has borne out that '*information processing*' operates serially when human beings perform the function of decision-making. What I want to emphasise is the fact that decision making is intimately connected with the functioning of human memory, the manner and form being the target of research. In this task, can philosophy help? If yes, where lies the similarity between philosophical speculation and the results of psychological research?

### 3. Cognition and Memory—Some Relevant Points From Philosophy

Researchers in cognitive simulation repeatedly encounter the problem ( in compiling simulation programs for the computer ) of building a model which will reproduce as faithfully as possible the human memory. But then what should be the distinguishing features between STM and LTM? Further, should primary memory be limited to the effects of the sensory mechanism? To quote Donald A. Norman, a prominent researcher in this field, commenting on the problems which beset the researcher :

- ( a ) "We have tried to demonstrate the existence of a short-term or primary memory system that is independent of any longer term or secondary store by showing that one function

relating probability of recall to a number of intervening items can describe a number of seemingly disparate sets of experimental results"<sup>(6)</sup> and,

(b) Finally, at what stage in the processing of incoming information does our primary memory reside? Is it in the peripheral sensory mechanism? Probably not. The work of Sperling (1960) indicates that 'Sensory memory' decays within a matter of milli seconds, whereas we have dealt in our analysis with retention intervals of the order of seconds. Does storage in Primary Memory precede the attachment of meaning to discrete verbal stimuli? Must a verbal stimulus be transformed into an auditory image in order to be stored in Primary Memory even if it was present visually?"<sup>7</sup>

At this stage, I would like to draw attention to the old debate between the Buddhists with their Kṣāṇikavāda theory of memory on the one hand, and the Advaita Vedantists (Śaṅkara) as well as the Mīmāṃsāvādists (Kumārila), on the other. Perhaps from the fallout of that debate, centuries earlier, present day researchers in cognitive simulation can profit.

The Buddhist explanation of the phenomenon of memory, given in Anuruddha's Abhidhammatha-Saṅgha is, "Each mental state is related to the next in at least four different modes of relation (paccaya); proximity (anantara), contiguity (samanantara), absence (Natthi) and abeyance (avigata). This four-fold correlation is understood to mean that each expired state renders service (Upakāra) to the next. In other words, each, on passing away, gives up the whole of its energy (paccayasatti) to its successor. Each successor, therefore has all the potentialities of its predecessors and more. This being so, the mental element or the principle of recognition or perception (Saṅṅā) in each of the mental states that take part in a memory process, with all its heritage of the past, is a recognising under favourable circumstances, in the image reproduced or the idea revived of the original object by the very marks which were observed by its predecessors in a certain intuition or reflection".<sup>8</sup>

Śaṅkara criticises the doctrine of momentariness, arguing that an individual's consciousness cannot be momentary since it belongs to an entity that is permanent. Thus, "We must admit

the permanence of the perceiving consciousness, since there is no other way in which the past cognition and the present may be held together and compared, so that a judgement of similarity may result".<sup>9</sup>

Again, the Mīmāṃsāvādists severely criticize the Buddhist doctrine of impression (vāsanā). "A preceding cognition that is entirely destroyed cannot modify the succeeding cognition. Even if they are produced simultaneously, they cannot modify each other because they are not related to each other. An impression is due to the operation of conjunction, inherence and the like, which are not possible if the preceding cognition is entirely destroyed before the succeeding cognition is generated".<sup>10</sup>

These two diametrically opposed view-points of memory are echoed in the questions which Norman raises viz.,

(i) If indeed sensory memory decays within a few milli seconds how do human beings retain impressions in the STM over a few seconds?

(ii) If STM and LTM are independent then what goes to constitute the LTM? We recognize the essential difficulty in establishing what is temporary and what is permanent. I venture to suggest that the Buddhist concept of Kṣaṇīkavāda (beautifully illustrated in the Vigñānshankrativāta by giving the example of one lamp lighting another before extinguishing itself), should be restored from its much maligned state and examined critically, so that it can help in model building of the memory process. A Śaṅkara or a Kumārila could logically destroy the Buddhist argument of Kṣaṇīkavāda but at that period the problem of differentiating between logic, thought and logical thought, did not exist. Hence if the 'process of thinking' could not be logically explained it was discarded. Nor did the dialectic approach to philosophy (metaphysics primarily) help, because whatever could not be explained by dialectic was held to be not valid. However, since modern philosophy (from the existentialists to the logical positivists) has developed to an extent where it is possible to distinguish between logic and thought, it can perhaps help in being able to explain the apparent discrepancies which stem from viewing the memory as a continuous process or as seemingly discrete phenomenon (the sensory perception, the STM and



the LTM) connected in a disjointed manner. (Perhaps the philosophical explanation of the quantum theory of Physics would be a useful analogy). But as Mandler bemoans, the field is now the preserve of the psychologist, not the philosopher; "Interestingly enough, it was only when logic, thought, and logical thought were clearly demarcated in modern times that the real argument over the relationship of each to other began. Only after the rift had become a chasm did it seem requisite to begin fitting them together again; this time, however, it was the psychologist who explored the nature of logical relations as the influence thought, not the philosopher using the psychology of thought (such as it was) to construct his logic. These problems have stayed with us until the present influencing points of view ranging from Piaget's to those of psychologists interested in computer simulation".<sup>11</sup>

Another suggestion which I have to make is that the Buddhist concept of *Ālayavijnāna*, where the interpretation of *Ālaya* is, "where there is no existence apart from itself". Thus, if we were to posit a permanent entity such as the *Ālayavijñāna* (roughly translated as consciousness devoid of all modality), then we could superimpose the structure of the doctrine of momentariness of this permanent entity. Thus Norman's contention of STM and LTM being independent can be seen in a new light, i. e. the STM existing in a continuous stream of LTM, yet not constituting it. The concept analogous to STM in Indian philosophy would be the *Buddhi* which is modal consciousness.

### CONCLUSION :

The researcher grappling with the important problem of understanding the 'process' of human memory, the core matter of research in cognitive simulation, can benefit from philosophy. His model building work can gain from understanding the various premises on which the theory of memory is developed in philosophy, and particularly the differences in the premises of the different schools of philosophy.

NOTES

- (1) Laurence Tribe — "Policy Science : Analysis or ideology". *Aldine Annual on Benefit-Cost Analysis*. 1972.
- (2) Herbert A. Simon — "On how to decide what to do" : *The Bell Journal of Economics*, Autum 1978, p. 502.
- (3) *Ibid.*, p. 502.
- (4) *Ibid.*, p. 503.
- (5) *Ibid.*, p. 503.
- (6) Donald A. Norman — "Memory and Attention", *New York, John Wiley and Sons* (1975), Chapter V.
- (7) *Ibid.*
- (8) Mrs. Rhys Davids and Aung — "Anuruddha's compendium of Philosophy".
- (9) S. Radhakrishnan — "Indian Philosophy", Vol. I, *George Allen and Unwin, London* (1929)
- (10) Indunath Sinha — "Indian Psychology", Vol. I, *Sinha Publishing House, Calcutta*, 1958.
- (11) J. M. Mandler and G. Mandler — "Thinking — from Association to Gestalt", *John Wiley and Sons, New York* (1964).

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