



## **The Burnt City and the Evolution of the Concept of “Probability” In the Human Brain**

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### **Dear Editor- in-Chief**

What we know about the Burnt City civilization is unfortunately limited to archeological findings and studies. We have no knowledge about the customs and rituals, beliefs, and myths of this civilization, which has made the analysis of archeological findings difficult. Therefore, our analyses are entirely based on speculations. However, I believe that one of the best ways to understand what happened in the Burnt City is to perform analysis regardless of the deficiencies and uncertainties.

The concept of causality is one of the most important concepts in human evolution. Our brain can establish a causal relationship between two relevant factors. The extent of the cause-effect relationship refers to the type of the relationship. As a result of what is called pre-logical mentality, the mentality of the primitive human established a cause-effect relationship between many topics that do not seem to be logically related (1). Examples of such relationships can be frequently found in myths of different nations. Therefore, the concept of “probability” and the entirely accidental occurrence of events did not occur to primitive human mentality. Studies show that causal thinking has deep roots in the brain which indicates the fact that throughout the evolution process, the brain has been trained to relate various phenomena to causal thinking (2). Moreover, studies have revealed that the causal understanding of simpler phenomena starts in the early ages and many processes that lead to causal understanding happen fast and automatically, and the brain understands

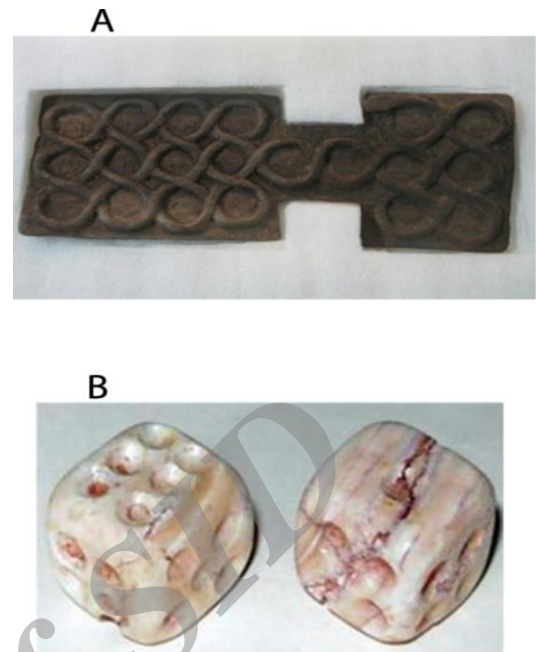
the relationship without any conscious effort to find the causal relationship between two phenomena (3). We have partially learned the neurophysiologic bases of this phenomenon. We know that causal processing happens in the visual system automatically and unconsciously. Studies using fMRI have shown that when the brain is exposed to two stimulations with a causal relationship, specific parts of the visual system, i.e. the bilateral superior temporal sulci, the left intraparietal sulcus, and bilateral V5/MT/MST areas demonstrate a significant activity bilaterally (3). This explains that the brain is hard-wired for receiving the causal relationship between two topics. However, the point is that none of the studies state that a specific area of the brain is activated due to the absence of a relationship between the phenomena, i.e. their accidental and probable concurrence. In other words, the human brain is perhaps not scheduled to understand accidental events (issues with probable or possibly accidental nature). Pre-logical mentality establishes a causal relationship even between unrelated issues due to its special mentality (1). It means that the aforementioned areas of the brain were very active in primitive humans and their visual experience of the outside world was completely active, alive, and based on establishing different relationships.

Therefore, the concept of the accidental event should be considered a later development that was achieved by the human brain following a lengthy process of evolution and gaining experience on

approaching different phenomena for which the brain might have not been rewired, yet. The fact that two phenomena can be unrelated and occur accidentally is a very deep concept, which is a basis for another deep concept that considers the occurrence of a phenomenon a probability not a certainty. The previously mentioned point might have not been considered very meticulously in neuroscience although it has been regarded significant and is an important entity in mathematics known as “the probability theory” since the time of Pascal and Fermat (two distinguished mathematicians). Historically, gambling and thinking about it has played an important role in the development of the probability theory (4). Gambling is a phenomenon with a highlighted role of chance or luck but gamblers gradually understood that there were rules which increased the probability of the occurrence of a phenomenon. Hence, I think that the manner of evolution of the concept of probability in the brain should also be studied in the history of gambling or other chance-based games.

One of the outstanding discoveries of the Burnt City is a backgammon board with pieces (checkers) and two dices. This backgammon made of ebony was found in the tomb no. 761 (Fig. 1-A) (5). The backgammon board was fashioned by 20 snake coils taking the tail into its mouth. Therefore, the backgammon has 20 points, 60 checkers, and 2 dices. Before this, the oldest backgammon board used to be the one found in the Royal Cemetery at Ur but the Burnt City backgammon board is quite older (5). It is interesting that there are two dices in this game because playing with two dices stresses the role of probability (the main topic of the article). The question whether probability could have any role in the civilization of the Burnt City will remain unanswered and we need to wait for more discoveries because the beliefs and myths of the people of the Burnt City civilization should be analyzed in order to find an answer to this question.

Discovering the mentioned backgammon with those specifications show that the Burnt City civilization could be one of the locations where the human brain started to form the concept of probability.



**Fig. 1 (A):** The backgammon board discovered in the Burnt City with checkers found beside the board. 1(B): Two dices. Available in [www.mehremihan.ir](http://www.mehremihan.ir)

This finding is of high significance from the point of understanding the manner of the development of cognitive capabilities in the human brain.

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