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RESEARCH ARTICLE

Role and Priming Effect of Pre-Acquired Memories in Abstract Decision-Making

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ABSTRACT
From a neuropsychological perspective, the brain is confronted daily by decision-making processes. Decision-making is influenced by many factors, from biological stimuli to reward assessments. In abstract decision-making, where no logical decision is forthcoming, choices still need to be made. Many priming factors can be involved in these decision-making situations. There is a need to understand what role pre-acquired memories (verbal, aesthetic, color, phonetic, emotional, etc.) play in abstract decision-making. Therefore, we conducted a survey of 40 people, including 14 (35%) men and 26 (65%) women aged 20 years (deviation = ±1.5), with medical backgrounds. All the questions in the survey form were abstract, non-binary, result-oriented, and had no specific logical answers. There was no specific priming information or reference clue that could direct participants towards a specific answer. This approach was taken so as to discover the real primer that the brain relies on when confronting abstract decision-making situations. From our analysis we found that previously acquired memories can influence persons' choices in abstract decision-making situations. Furthermore, we concluded that these memories have unconscious, subtle, and long-term priming effects.

KEYWORDS: Priming, Memories, Abstract Decisions, Decision-Making, Potentiation.

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INTRODUCTION

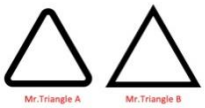
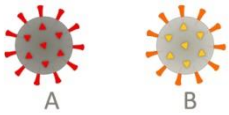
Decision-making is a perpetual process, regardless of any conscious acknowledgement thereof. Natural decision-making is built on the experiences that enable people to rapidly assess situations and make effective decisions [1]. From adolescence onwards, there are various models that propose to understand judgment and decision-making [2]. Choosing between different options is not just a one-factor random process; it involves the influences of multidimensional aspects, including cost vs reward strategies [3], neurobiological pathways [4], and neurochemical pathways [5]. Many external representative factors can affect the decision-making process [6,7]. Decision-making can also occur as a result of "priming" [8]. The priming effect is a phenomenon in which exposure to one stimulus, or a group of stimuli, influences the response regarding a subsequent stimulus, without conscious guidance or intention [8]. Many studies have been designed to assess the influence of the priming effect on decision-making; especially with regard to verbal contexts, cognitive responses to tasks, etc. [9-11]. The priming effects are usually either short or medium in duration. Some scenarios have abstract natures, and the decisions that have to be made in relation to these scenarios do not necessarily have a logical explanation or use a cost vs reward system to rationalize the decision [12]. Nevertheless, in such chaotic situations people still make decisions. There must be some sort of long-term memory potentiation in the brain that primes people to make decisions in these abstract situations. Knowledge is needed to understand how great impact pre-acquired memories (such as verbal, aesthetic, color, phonetic, emotional, etc.) have on abstract decision-making. In addition, we need to determine whether these memories have a long-term priming effect [13].

MATERIALS AND METHODS

Survey : A survey of 40 participants was conducted to analyze the effect of memory on the priming of abstract decision making. Of the 40 participants, 14 (35%) were male and 26 (65%) were female. The participants were 20

years of age (deviation = ±1.5). An online form was used to implement and access the survey. The survey form consisted of 7 questions as displayed in Table 1.

Table 1. List of questions as they chronologically appeared in the survey form

Sr.no.	Question	Options/Image
1.	There are two-men Named Mr. BOB and Mr. KIKI. One of them is Fat and healthy and other is Thin and lean. Who do you think is Fat and Why?	BOB KIKI
2.	There are two shapes, Triangle A and Triangle B. One is loving and caring while other is angry and violent. Which one of the shapes do you think is angry and violent? What memory/Event/Object/ lead you to choose your answer?	
3.	What do you think the shape given below is and why?	
4.	Which of the following do you think is safe and why?	
5.	As medical students, without consulting a dictionary, what is the meaning of the words VAGILE and PENAL?	Not applicable
6.	Which of the following pictures would you choose, and why?	
7.	What do you think this image is/ What does the image resemble to you and why? What memory/Event/Object lead you to associate this image with your answer?	

All the questions in the survey form were abstract, non-binary, result-oriented, and had no specific or logical answers. There were no specific priming information or reference clues in the questions that could lead participants towards a specific answer; this was done so that the real primer could be triggered when the brain confronted an abstract decision-making situation. The first question was sourced from existing literature regarding the "Bouba/Kiki effect" [14], although we made a few alterations [15]. Instead of assigning names to the available shapes (which is the usual way), we made participants guess which name corresponded with which description of the person; furthermore, we changed the name Bouba to Bob, and Kiki was kept as it is. The second question aimed to discover the effect of shapes, edges, and aesthetic illustration [16] on abstract decision-making. The third question consisted of a random figure [17,18] that does not represent a real-world object; this could shed light on how pattern/feature mapping could result. The fourth figure consisted of the same image in different color options; this may demonstrate how color memory [19] plays a role in abstract decision-making. The fifth question was a guessing question regarding the meaning of two words; it aimed to determine how known phonetics or spelling resemblances [20] may influence the discovery of a new meaning. The sixth question attempted to verify how decisions are prioritized when different iterations of the same locus are available for choosing. The last question required participants to guess what a painting was portraying; the painting contained abstract brush strokes of blue and brown tints. This question was to verify what meaning assignment [21,22] is done to abstract objects in context.

Observation : The results we collected consisted of participants' answers and the corresponding justifications of their choices. These justifications included which memory, event, or object made them think of their answers. The collected results were revised to eliminate typographical and semantic errors, and to remove invalid and multiple entries. All the results are shown in Table 2.

RESULTS

In the first question, 95% of the participants chose "BOB" as their answer. In the second question, 85% chose "Mr. Triangle B." In question 3, meaning had to be assigned to a random shape or image; there was a minimum of 10% and a maximum 30% similarity in the answers i.e. "sheep/grass/heart." Totally, 87.5% of the participants selected "Image B" as safe in answer to question 4. In question 5, 10 out of 12 of the participants guessed that the words probably referred to body parts (Vagina or Penis). In question 6, 50% of the participants selected "option A." Finally, 62.5% of the participants

associated the painting image with a waterfall, in question 7.

Analysis : The analysis of the survey results is laid out in Table 3. In question 1, regarding the participants' comments on why they selected the name BOB, most participants relied on phonetics/pronunciation and the appearance of the letter O in the name BOB since no other visual cues were available. Therefore, the shape of the letter O along with the auditory reflex of pronunciation, triggered by participants' memories, primed their selection. Totally, 95% (38 out of 40) of participants chose Bob as the Fat person despite the absence of a visual clue or any other clue available.

Table 2. Results of the survey

Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7
38 participants selected BOB	34 selected Mr. Triangle B	12 say that the shape resembles an animal, mostly goat/sheep/Butterfly	35 participants selected option B as the safe option	17 knew one or both of the words' meaning	20 chose option A	25 said the image resembles a waterfall
02 participants selected Kiki	06 Selected Mr. Triangle A	07 say that the shape resembles grass/shrub, mostly grass	05 participants selected option A as the safe option	10 did not give an answer	04 chose option B	03 said the image resembles Space
		07 say that the shape resembles a heart		13 did not know one or both of the words' meaning but tried to answer	07 chose option C	07 said the image resembles Nature, some included water in it
		03 did not attend Question		10 out of 13 who attempted said it was a body part (Vagina or Penis)	09 chose option D	05 did not answer the question
		11 gave random answers				

Table 3. Statistical analysis of the results given in Table 2

Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7
95% of the participants selected BOB as the answer (Fat and Healthy)	85% selected Mr. Triangle B as the angry and violent one	30% saw an animal mostly goat/sheep/Butterfly. 17.5% saw grass/shrub mostly grass 17.5 saw a heart	87.5% selected 'Image B' as Safe	83.3%, who did not know the answers guessed they were body parts. (Vagina or Penis)	50% chose 'Option A'	62.5% said the image resembled a 'waterfall'

Second, when selecting which shape looked violent and angry, 85% (34 out of 40) of the participants chose the shape (Mr. Triangle B) that had sharp edges. Participants solely relied on their intuitions in this decision; their comments indicated that they related sharp edges with violence, and no other clues or stimuli influenced their decisions. We can thus deduce that their memories of sharp objects/weapons creating wounds or used in acts of violence, as seen in the real world, triggered their decision that sharpness, pointedness, or razor edges represent violence.

In question 3, 30% (12 out of 40) of the participants associated the random shape with an animal, mostly goat/sheep. Totally, 17.5% (7 out of 40) of them associated the random shape with grass/shrubs, while 17.5% (7 out of 40) associated the random shape with the human heart. In total, 3 participants did not respond to the question and the rest gave different random answers. By analyzing the comments on what lead them to associate the shape with these objects, we found that people based these visual relationships on previous memories. Even slightly matching the partial feature of the shape with previous memories lead them to guess the shape. None of the participants selected any resemblance to the shape that has a low visual connection with previous experiences.

In the selection scenario of question 4, 87.5% (35 out of 40) selected B as the safe option. The shape and size of the image remained invariant; therefore, participants relied on memories of color, triggered by potentiation in their brains, to make a decision. The memories of red being used in alert signs may have triggered their choice of regarding orange as safe.

In question 5, out of the 12 people who guessed at the meaning of the given words, which was the intention of the question, 10 people associated the words with the existing vocabulary and phonetics present in their memories. Therefore, it is evident that people bifurcated the pronunciation of the words to recall words that may seem similar. Since vagile and penal sound and look similar to vagina and penis, respectively, the participants decided the words were related to these body parts.

In question 6, participants had to choose a random variation of the "infinity" sign, which each had a unique design aesthetic; 50% (20 out of 50) of the participants chose shape A. From the participants' comments it is

clear that they chose the shape that was clearer in terms of width, structure, and curvature than the shapes that were more design integrated and aesthetic. This may be indicative that the brain neuropsychologically chooses options that are clearer and less confusing.

Regarding question 7, 62.5% (25 out of 40) of the participants said that the painting resembled a waterfall and a further 7 said it resembled nature. Their comments on what lead them to these conclusions, revealed that the blue tones and vertical brush strokes primed them to think of a waterfall. They also said that it elicited older pictorial memories of actual waterfalls.

DISCUSSION

From the above survey analysis, we can predict that previously acquired memories may influence peoples' choices in abstract decision-making scenarios. A decision based on logic is not possible, since there is no analytical data available; however, pre-existing memories may assist in making abstract decisions. Moreover, memories do not only affect choices but also have unconscious, subtle, and long-term priming effects. Memories subjective to visual representations, emotions, aesthetics, the senses, etc., —individually or in combination—may trigger a priming effect on a new stimulus if the stimulus is presented in a similar context [23]. This priming effect can be independent of neurophysiological states. However, there was a high similarity between the participants' choices, with regards to the interpretation of meaning in the survey [24]. This may have resulted from the limited sample group of participants, who might all have similar cultural, environmental, and domain-specific memories. Therefore, a greater cross-sectional study is needed to further study the psycho-analytical effect of memory on abstract reasoning and decision-making. Nevertheless, our current data is evidence that long term memory potentiation has a prolonged effect in abstract decision-making.

Research involving human participants: The studies involving human participants for "Role of pre-acquired memories in abstract decision making and its priming effect" were reviewed and approved by Agricultural Development Trust, Shardabai Pawar college of Pharmacy The total participants were 40 and are bonafide students of our organization. The participants of the survey have provided their written informed consent to participate in survey.

CONFLICT OF INTEREST

The author declares that the research was conducted in the absence of any commercial or financial relationships that may be construed as a potential conflict of interest.

AUTHOR CONTRIBUTIONS

Corresponding author is sole contributor to complete survey analysis and manuscript.

FUNDING

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