

Correlation between Various Memory Assessment Tasks

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Abstract: Human memory can be assessed through various tasks. There are various types of computer based memory tasks. These tasks are of different time duration and give various parameters to conclude the state of human memory. The current study is to verify that the tasks like DSPAN, CORSI and STERNBERG for short term memory are not related and represents various aspects of human memory. The coefficient of variance is calculated for each task. The Pearson coefficients between scores of the tasks bearing highest coefficient of variance is calculated and it is found that DSPAN and CORSI are different tasks and thus should be performed to assess human memory.

Keywords: DSPAN, CORSI, Memory assessment, Memory tasks, Psychological experiment building language (PEBL), Pearson Coefficient, Sternberg.

1. Human Memory

Memory is the ability to encode, store, retain and subsequently recall information and past experiences in the human brain. It acts as a connection between the past and present. The past experiences decide our present behaviour [1].

We can make use of our memory by recalling, recognition and relearning [2]. To recall or remember something is to revisit the information. For example, name of the capital which we have already learnt is recalled during exams. Recognition can be understood as finding a correct piece of information out of a large piece of information. In other words, we tend to compare our old experiences with the new ones for similarities. This case is similar to multiple choice questions. Relearning is studying the same information over and over again. This leads to strong neural connections in the brain.

2. Memory Recall Cycle

Memory model is the process through which information is stored in the brain. There are various stages through which information flows till it is ultimately stored. This was first given by Atkinson and Shiffrin in 1968.

The process starts with the stimulus which activates our senses. Our sensors generate signals which go into sensory memory and then these are encoded to be sent to buffer memory. We have various types of sensory memory such as iconic memory (vision), echoic memory (audio), but only certain information is passed to buffer memory after encoding. The buffer memory is nothing but our working memory. Short term memory holds only those information which we are conscious of or needs processing. As soon as we divert our attention towards something else, the information either gets lost in a very small duration of time or is stored in long term memory [3]. Other type of memory is long term memory in which information is stored for a longer duration of time, even for complete life time. This is achieved because there is a change in brain wiring. It's just like a hard wired logic in a computer. The information in long term memory gets stored in accordance to meaning and it is classified as explicit and implicit memory. Explicit memory is memory of facts and experiences that can be consciously understood and declared. Implicit memory has those experiences which are stored unconsciously and retrieved also. The fig 1 depicts the flow of information in memory.

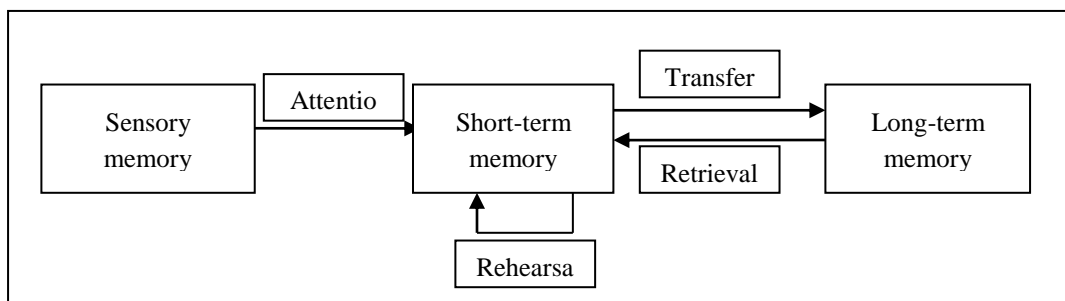


Fig1: Human brain multi store memory model

3. Memory Assessment Tasks

Human memory is very versatile. It can store various types of sensory stimuli. To assess the capability of human memory there are various types of memory tasks. For Short term memory, we have verbal and non-verbal memory tasks which include Dspan, Sternberg and Corsi[4]. These are computer based tasks and their various variants are available over internet as psychological test batteries like Psychological experiment building language(PEBL)[5].

3.1 Digit span (Dspan)

In this assessment task a series of numbers appear on the screen one after the other as shown in fig 2. The participant has to learn the digits in the order appeared on the screen. After a brief interval of time, the participant has to punch the digits in the same order as it appeared on the screen. For every two consecutive right responses, the length of digits increases by one. And if there are two wrong responses in succession the task will end.

The maximum length of digits retained by the participant is taken as its memory span[4].



Fig 2: Task Digit span[6]

3.2 Sternberg

Sternberg comes in category of short term verbal memory. The objective of this task is to check the number of letters that a participant can remember and recall accurately[7]. The task starts with a fixation point appearing in the middle of the screen for 5 seconds. Immediately after this fixation point is disappeared, a single character appears and stays for 2.5 seconds. This time period is called as probation period. Just after probation period, 3.5seconds are given for retention of the character. After retention period, a stimulus of single character appears on the screen for 2sec. During this time period the participant is supposed to respond by pressing Key L if the character was the same that he had learnt during retention period else he is supposed to press A. the timeline of the task is shown in fig 3.

The same task is repeated with five characters with increased memory work load. Here the subject is supposed to learn 5 characters during the retention period. For every correct response, a score of '1' is awarded. The stimuli appear 18 times on the screen.

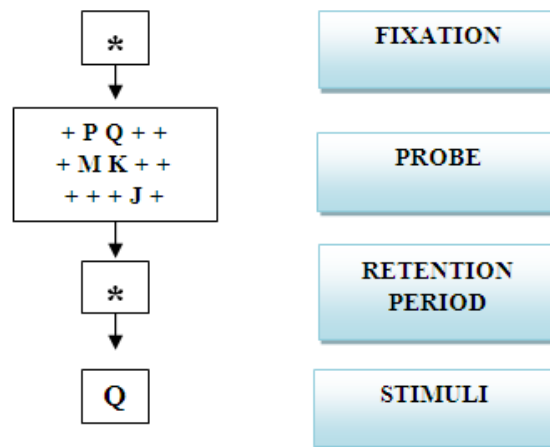


Fig 3: Task Sternberg

3.3 Corsi

In this test nine blue coloured square blocks will randomly appear on the computer screen. One block per second will get illuminated with a yellow colour and the participant will have to memorize the trail. After the completion of the trail, the participant has to recreate the trail by pressing these blocks in the same order as they appeared on screen. The blocks are shown in fig 4. This test evaluates the visual spatial memory. For every correct response the memory load tends to increase by '1' [4].

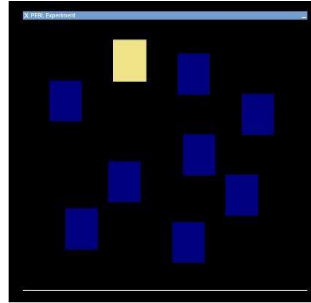


Fig 4: Task Corsi[8]

4 Method

For this study, 14 engineering students in the age group of 19 to 25 were selected. Only those students were selected who had no neurological and psychological disorders. Also it was made sure that no student was under any type of medication. The selected students were instructed to perform the short term memory tasks in a quiet room. All the tasks namely Corsi, Dspan and Sternberg were computer based tasks. Psychological Experiment Building Language (PEBL), open source software was used for performing Corsi and Dspan whereas PsychoPy was used for performing Sternberg. Memory spans were obtained in case of Corsi and Dspan. In Sternberg task, a score of '1' was awarded for every right response.

Statistical Analysis of Data

For statistical analysis of data, Pearson coefficient is calculated between the memory span and score.

Memory span for Corsi is automatically generated at the end of the task and is given equation 1.

$$\text{Memory span of Corsi} = \frac{\text{Start length} + \text{Total Correct}}{\text{Trials Per Length}} \quad (1)$$

Memory span for Dspan is the maximum length of digits correctly recalled by the participant.

For Sternberg task, a score of '1' is awarded for every correct response and the stimulus appears ten times in the first task and eighteen times in the second task. Total score was then summed up at the end of the task.

Coefficient of Variance

It is a statistical parameter to find the dispersion of data array around the mean. It is given by equation 2.

$$c = \frac{\text{Standard deviation}}{\text{mean}} \quad (2)$$

Where 'c' is Coefficient of Variance.

Pearson's Coefficient

It is a statistical parameter which is used to find the relationship between the two data arrays. Pearson's coefficient is given by equation 3.

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}} \quad (3)$$

Where r Pearson's Coefficient, x_i is first vector, y_i is second vector, \bar{x} , \bar{y} are mean values.

A value of Pearson's coefficient of |0.1| to |.3| represents poor correlation, |.3| to |.5| moderate and |.5| to |1| strong correlation.

5. Result and discussion

Table 1 depicts the scores and memory span obtained for each participant. The coefficient of variance is calculated for each task. It is depicted in table 2.

Table 1: Scores and Memory Span

| Subject | Memory Span (Corsi) | Memory span (Dspan) | Sternberg score 1 | Sternberg score 2 |
|---------|---------------------|---------------------|-------------------|-------------------|
| 1 | 5 | 8 | 10 | 18 |
| 2 | 5 | 6 | 8 | 17 |
| 3 | 8 | 10 | 10 | 18 |
| 4 | 7.5 | 9 | 9 | 14 |
| 5 | 5.5 | 7 | 8 | 17 |
| 6 | 6.5 | 8 | 8 | 17 |
| 7 | 6.5 | 5 | 10 | 18 |
| 8 | 6.5 | 7 | 10 | 18 |
| 9 | 5.5 | 7 | 9 | 17 |
| 10 | 4.5 | 8 | 10 | 16 |
| 11 | 6.5 | 8 | 9 | 18 |
| 12 | 5 | 8 | 10 | 18 |
| 13 | 6 | 8 | 10 | 18 |
| 14 | 5 | 9 | 7 | 17 |

Table 2 Coefficient of variance

| Tasks | Memory Span (CORSI) | Memory span (DSPAN) | Sternberg score 1 | Sternberg score 2 |
|--------------------------------|---------------------|---------------------|-------------------|-------------------|
| Coefficient of variance | 0.174595 | 0.164195 | 0.11234 | 0.065162 |

It can be seen from the table that the coefficient of variance is higher for DSPAN and CORSI.

Also the Pearson's coefficient is calculated between the tasks DSPAN and CORSI depicted in Table 2.

Table 3: Pearson coefficient for correlation between tasks

| TASKS | Pearson Coefficient |
|----------------------|---------------------|
| Corsi – Dspan | 0.305924 |

Conclusion

The coefficient of variance was calculated between the scores of the tasks. It was observed that the coefficient of variance for the task DSPAN and CORSI were the highest. So in study related to enhancement we can choose these two tasks. Also the Pearson's coefficient calculated between the selected tasks i.e. DSPAN and CORSI was observed to be 0.3. This value is very less and therefore these two tasks are not related. So in order to assess various aspect of memory we should perform both the tasks.

Future Scope

The DSPAN and CORSI memory tasks were found to be different and assess various aspects of human memory. The task DSPAN is a verbal memory task whereas CORSI is a spatial memory task. These tasks may be used to assess the memory enhancement by comparing pre and post intervention memory assessment task results.

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