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Robbins *et al.* 1996)

Working Memory in Chess

This study is used to answer questions on:

working memory
dual processing
levels of processing

Abstract

This was a series of three experiments (only two are outlined here) based on the ability of chess players to analyse/remember chess positions whilst experiencing disruption to different sections of their working memory.

Participants were divided into 4 groups: control group, phonological loop, visuo-spatial sketchpad and central executive.

In experiment one, participants saw a chessboard position for 10 seconds then tried to re-create it on a separate board. Apart from the control group, distractor tasks based on the different sections of the working memory model were also used.

In experiment two, the procedure was largely the same except participants needed to find the best moves in a chess position rather than just remember the location of the pieces.

It was found that the phonological loop does not affect the efficiency of playing chess, but the visuo-spatial sketchpad and central executive are very important. Also, better chess players showed less distraction. The researchers concluded that stronger chess players encode their chess memories (and interpret them) semantically, allowing them greater access when some of the short-term memory is impaired.

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Experiment One – Remembering Chess Positions

Aim

- To test the effect of blocking the Visuo-spatial scratchpad, Phonological loop and Central Executive on immediate memory (working memory model)
- To test if memory can be recalled accurately if secondary tasks are undertaken (dual processing)

Method

Participants

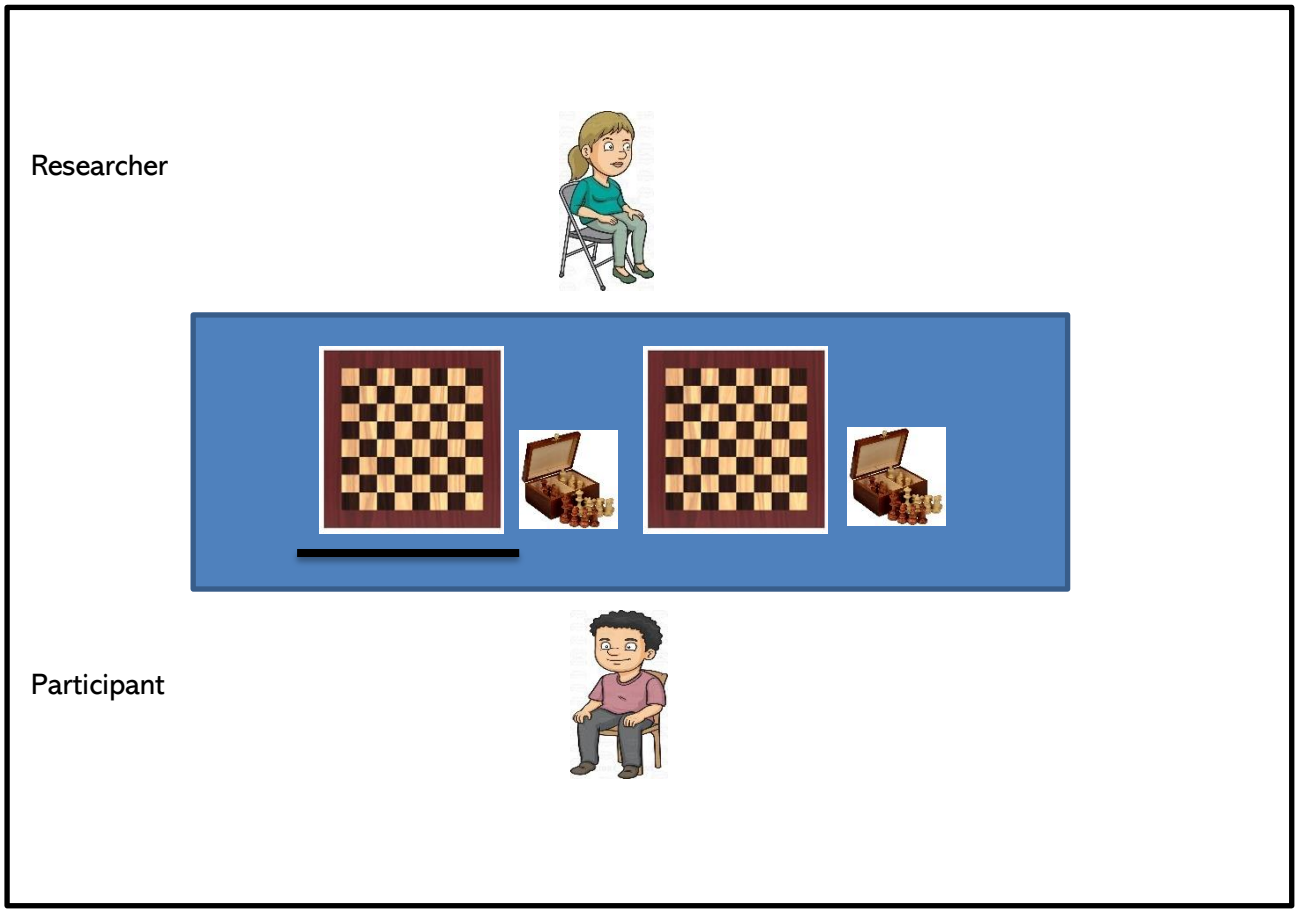
20 participants were recruited from Cambridge University Chess Club and local chess clubs. Almost all the players were 30 years old or younger. Participants were divided up into two groups: weak players and strong players.

Procedure

20 different chess positions were chosen by the researchers. Each position involved 16 chess pieces (8 white and 8 black).

The participant sat in a quiet room at a table. On the table were two chessboards with full chess pieces next to each board. There was a partition in front of the board on the left, so the participant could not see it.

Diagram 1. Experiment setup



The researcher set up one of the 20 pre-decided positions on the hidden board. Once ready, they then removed the partition for 10 seconds to allow the participant to study the board. After 10 seconds, they replaced the partition, so the participant could no longer see the board.

The participant then used the chess pieces to recreate the position on the other board. They did not have a time limit but were encouraged to not take longer than 1 minute. Once finished, their reconstruction was recorded, and the boards were reset for the next position. The participants completed 4 positions in total before the end of the experiment. The pieces were arranged twice with black pieces facing the participant and twice with white pieces facing the participant.

There were 4 different conditions used in the experiment.

Condition 1 – Control Group

The procedure was the same as described above.

Condition 2 – Interrupting the Phonological Loop

The procedure was the same as the control group except the participant was required to repeat the word *the* throughout the test. They repeated the word at a one-second interview that began before the partition was raised and stopped when they had completed placing the pieces.

Condition 3 – Interrupting the Visuospatial-sketchpad

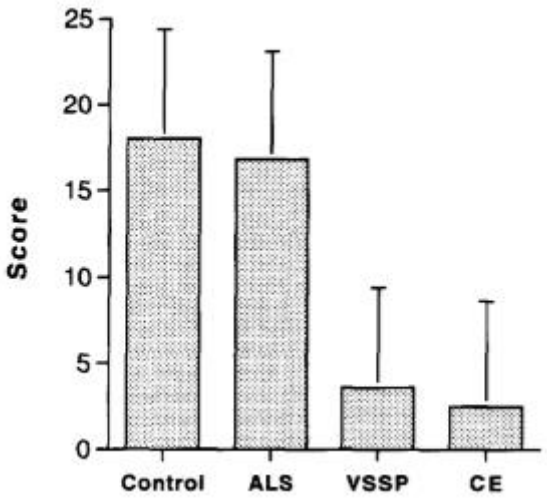
The procedure was the same as the control group except the participant was required to continually press buttons on a specially prepared calculator. There were 16 buttons that were pressed in order (a 4 x 4 grid and the participant pressed the top four buttons one-by-one then the next row until reaching the final button where they continued by going back to the first button). They calculator was hidden beneath the desk so the participant couldn't see it during the experiment.

Condition 4 – Interrupting the Central executive

The procedure was the same as the control group except the participant was required to call out random letters of the alphabet at one second intervals during the test.

Results

Each combination completed by the participant was given a score. They were given 1 point for having a piece in the correct place but lost 1 point for every piece in the wring place. They were given bonus points if they had pieces in the correct formation but on the wrong squares.



The results show that the Phonological Loop is not a factor in remembering chess position as the results were almost the same as the control group (labelled as ALS in the graph above because the term has changed since this study was conducted). The visuo-spatial sketchpad and the central executive seem to be very involved in chess problems as participants in those conditions scored very low.

The strong players were also less distracted by the tasks, scoring higher than the weaker players.

Experiment 2 - Moving Chess Pieces

Aim

To provide more evidence of the use memory in playing chess, rather than just memorising positions

Method

Participants

12 chess players (all from Cambridge University Chess Club) took part. None of them had taken part in experiment 1.

Procedure

The method used was almost identical to the first experiment, but instead of memorising positions, participants were shown positions and asked to suggest the best moves. They were told that, in a few moves, it was possible to force a checkmate or win a substantial piece. They were given 3 minutes to study the board then write down their analysis of the best moves.

Again, there were 4 conditions.

Condition 1 – Control Group

Participants pressed a button every 2 seconds while completing the task.

Condition 2 – Phonological Loop

Participants repeated the word *see-saw* every second while completing the task.

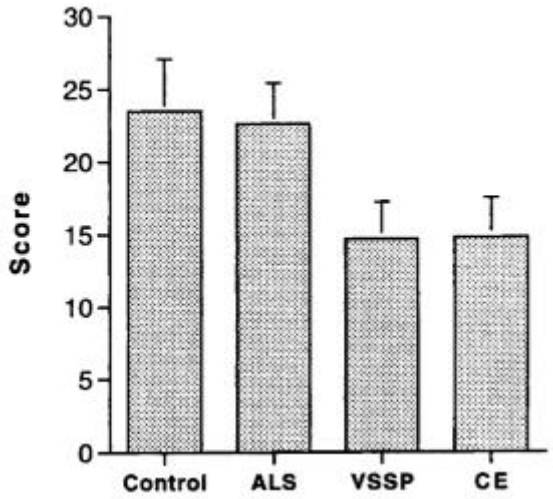
Condition 3 – Visuo-spatial Sketchpad

Participants used a 3 x 3 grid of buttons and were required to press the buttons around the central button clockwise in order.

Condition 4 – Central Executive

Participants repeated the same activity as experiment one, saying random letters – however, they were required to do so after 2 seconds rather than 1 second.

Results



As with the first experiment, the phonological loop does not appear to play a role in chess, but the visuo-spatial sketchpad and central executive are important.

Conclusion

Verbal memory (the phonological loop) plays very little role in chess. It seems likely that stronger players encode long-term chess memories semantically (by analysing the meaning of positions) as opposed to weaker players who encode structurally (by considering positions good or bad). This means they can still function well when the systems are blocked by accessing the long-term memory, but not at optimal performance as the central executive cannot organise the information efficiently.

Evaluation

Generalisability

- There was a reasonable sample of 47 participants over all the experiments.
- The participants were all chess players, so they may have a unique or specialised memory type through their exposure to analytical thinking. The researchers tried to address this by looking at weaker and stronger players.
- The participants were all from Cambridge University or Cambridge Chess clubs. It is possible students accepted to Cambridge University have greater memory capabilities than non-Cambridge students.

Reliability

- The chess playing levels of the participants was rated using an internationally recognised system.
- The chess puzzles were taken from obscure games and even were modified by the researchers to make sure that chess players were not familiar with the position.

Application to life

- An understanding of the essential factors of the working memory model could help chess players.
- An understanding of the role of the different sections of the working memory model could teachers when devising lessons.
- It may be possible to use the findings to better understand how working memory can affect people suffering from autism.

Validity

- The experimenters tested all the aspects of the working memory model, making this a comprehensive examination.
- The experiment was ecologically valid for the participants as it is likely they would spend time analysing chess positions.
- However, the secondary tasks (pressing buttons or saying words or letters) are not a normal part of life.
- Participants were all 30 or under, so no degenerative factors such as memory decreasing with age should have been present.

Ethics

- Participants were not asked to partake in any activity that could be damaging to them (although it may have been frustrating).

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