



## Playing Chess Game: Cognitive function and Behavioral skill Enrichment

**Dr Sultana J . Ahmed** Associate Professor, Deptt of Community Medicine, AMC

**Mir Alam Siddique** MBBS, MS, PhD Regional Institute of Ophthalmology, Guwahati

### ABSTRACT

Chess is a mental game played by two players using a board of 64 black and white squares and 16 pieces each. The involved cognitive processes in chess playing are stimulated and reinforced by practicing this game, resulting in learning-induced neuroplasticity. Cognition means operation of the mind process by which we become aware of objects of thought and perception, including all aspects of perceiving, thinking and remembering. Magnetoencephalographic recordings of single slices indicates pronounced activity in the region of the perirhinal and entorhinal cortex, hippocampus and related structures in amateur players, but not in grandmasters. The mean score of dichotic auditory-verbal memory test between the two groups, expert chess players and non-chess players, revealed a significant difference ( $p \leq 0.001$ ) in research. Bilateral activation was revealed in the superior frontal lobes, the parietal lobes, and occipital lobes. For optimal growth and development of children, we should administer them proper nutrition with balanced diet, adequate physical activity and mind game like chess by maintaining correct body posture.

**KEYWORDS :** Chess game, Cognition, Memory, Behavioral skill

### Full Text

Chess is a mental game played by two players using a board of 64 black and white squares and 16 pieces each.<sup>1</sup> Chess gained attention in the academic field since some researchers argues and proved that chess skills lead to the improvement of academic achievement due to their transferability to other areas.<sup>2</sup>

While players get fun in playing chess, many kinds of cognitive processes are involved as for example memory, working memory, attention, visuo -spatial perception, motivation and decision making.<sup>(3,4,5)</sup> Cognition means operation of the mind process by which we become aware of objects of thought and perception, including all aspects of perceiving, thinking and remembering.<sup>6</sup> Essentially, invisible activities of the brain such as perception, memory, thinking, reasoning, learning, attention and logical performances are addressed as cognitive performances.<sup>7</sup> The involved cognitive processes in chess playing are stimulated and reinforced by practicing this game, resulting in learning-induced neuroplasticity. Cognitive performance is an important aspect of a person's life.<sup>8</sup>

Memory is a part of cognitive performance that addresses the learning endurance or its resistance in a way that is recallable after a while. This ability for representing and retrieving information has a fundamental importance for all cognitive phenomena.<sup>9</sup> Memory is categorized into two types of verbal and non-verbal according to the nature of the memorized material. The auditory-verbal memory is a type of memory that involves auditory reception of orally presented information, its processing, and storing and finally recalling what has been heard. This kind of memory is extremely important because it plays a fundamental role in developing language skills and the learning process in general; therefore, the auditory-verbal memory helps us to make sense of language and without it, language will be meaningless and void of any concept. The auditory-verbal memory is one of the basic parts of working memory, and working memory is a transitory and temporary way of keeping information that is limited in capacity and needs to be repeated.<sup>10,11</sup>

In the field of higher cognitive performances including memory, planning and problem solving, there are many studies and experiences in both sports and educational domains which address the topic of chess.<sup>12,13</sup>

Long term gain of skills and repeating the exercise of proficiency in chess can result in considerable changes in the neural structures that are concerned with this special skill. Neuroplasticity studies in the field of learning or exercising chess or other games that are

similar to chess, using brain imaging techniques, have reported changes in the areas associated with a special skill as a result of intense and repeated activity of these areas.<sup>14</sup>

So far, many studies have analyzed the brain structure of expert and novice chess players, using brain imaging techniques. The common finding of these studies is different activities of the brain structures between novice and expert chess players. For example, Wright et al. (2013) used the event-related potential test to analyze the underlying neural events when chess players made simple judgments of a chess position. They observed that the P3 and N2 amplitudes were larger in expert chess players when compared to novice players.<sup>15</sup>

Amidiz O et al conducted a study among 20 male players (aged 42\_14years), each with more than 10 years of tournament and training practice. Ten professional grandmasters scored between 2,400 and 2,600 on Elo's chess-skill rating scale; amateur players ranked 1,700 and above. Magnetoencephalographic recordings were made while subjects played against a computer and were scanned in the 5 seconds after each move by the computer program for focal  $\gamma$ -bursts (20–40 Hz; Fig. 1a). Examination of single slices indicates pronounced activity in the region of the perirhinal and entorhinal cortex, hippocampus and related structures in amateur players, but not in grandmasters. There was a strong negative correlation ( $r = -0.84$ ) between the relative share of dipoles in these structures and Elo chess skill (Fig. 1b). The correlation was also significant when only the 12 players who had lost in the game were included in the analysis (draws and wins were achieved only by grandmasters). There was no relationship between the length or complexity of the game and the Elo score. Their results indicate that the activation of expert memory chunks produces focal  $\gamma$ -band activity in the neocortex, whereas amateur players primarily encode and analyse new information, tasks that activate the medial temporal lobe and the hippocampus. It is possible that these structures play only a transitional role during the establishment of expert memory in the neocortex.<sup>16</sup>

Atherton M et al conducted a study employed functional magnetic resonance imaging (fMRI) to identify cortical areas that are active during the analysis of chess positions compared with a spatial task with matched visual stimuli. Bilateral activation was revealed in the superior frontal lobes, the parietal lobes, and occipital lobes. Some small areas of activation were observed unilaterally in the left hemisphere. The left hemisphere showed more activation than the right.<sup>17</sup>

Fattahi F, et al conducted a cross-sectional study among 30 expert chess players (15 males and 15 females) aged 20 to 35 years with a

mean $\pm$  SD age of 26.8 $\pm$ 4.59 years, and 30 non-chess players (15 males and 15 females), without chess game experience, aged 20-35 years with a mean $\pm$  SD age of 26.5 $\pm$ 4.10 in Tehran Chess Board. The participants were selected randomly. Expert chess players were selected from those who had a rating over 2000 and were accepted in the final national tournaments of the Iranian chess federation and had more than 5 years experience of participation in national and international chess tournaments. In this study, to ensure that the auditory threshold was normal and symmetrical for the participants, pure-tone audiometry was performed in a silent environment without other competitive stimuli, using a clinical audiometer based on the ASHA 2004 standard. Then, using the Persian version of DAVMT(dichotic auditory-verbal memory test), auditory memory was evaluated in the individuals who had the inclusion criteria. The test consists of six lists, each of which containing 10 words. In this test, when a word presents to one ear, the reverse of the word is also presented simultaneously to the other ear. The participants received the following test instructions before starting the test: "You will hear a real word in one ear and a nonsense word in the other ear; pay close attention to the real words coming from either the right or left ear and try to remember them. When the listening is over, say the words that you remember; the order in which you recall them is not important." At the end of each list presentation, words were recorded in order of remembering. To increase the reliability of the results, the test was administered to each ear three times, and each time a different list was used. To calculate the mean score of DAVMT for each individual, the average score of three lists that was presented to each ear was considered as its score, and the average score of both ears was the total score of the individual.<sup>18</sup>

The mean score of dichotic auditory-verbal memory test between the two groups, expert chess players and non-chess players, revealed a significant difference ( $p \leq 0.001$ ). The difference between the ears scores for expert chess players ( $p = 0.023$ ) and non-chess players ( $p = 0.013$ ) was significant. Gender had no effect on the test results. To analyze the influence of the ears in each group separately, test results of the right and left ear were compared using paired t test. The results revealed that the difference between the scores of the two ears was significant in both chess players ( $p = 0.023$ ) and non-chess players ( $p = 0.013$ ).<sup>18</sup>

A phenomenon peculiar to childhood is growth and development. The term growth refers to increase in physical size of the body and development to increase in skills and function. Growth and development are considered together because the child grows and develops as a whole. For optimal growth and development of children, we should administer them proper nutrition with balanced diet, adequate physical activity and mind game like chess by maintaining correct body posture.

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