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The general intelligence and spatial abilities of gifted young Belgian chess players

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Thirty-three tournament-level young Belgian chess players aged 8 to 13 were tested with the French WISC (Wechsler Intelligence Scale for Children) The mean full scale IQ = 121, verbal IQ = 109 and performance IQ = 129. The results suggest that a high level of general intelligence and of spatial ability are necessary to achieve a high standard of play in chess. The high spatial ability of these young chess players suggested by the high performance IQs may go some way towards explaining why males tend to be more numerous than females among high-standard chess players.

The question has often been asked whether it is necessary to have a high level of intelligence to achieve a high standard of chess playing, or alternatively whether chess is a narrow and isolated skill which can be learned by children of average or even low intelligence, rather like the specific calculation and memorization skills of idiots savants. Most writers have taken the view that 'chess skills are specific, denying that chess players as a group have any exceptional mental talents' (Holding, 1985, p. 271), but there is no satisfactory evidence to support this conclusion. The purpose of the present paper is to provide what is believed to be the first evidence on this question.

The problem can be posed as three hypotheses with empirical consequences which are tested by the study. Hypothesis 1 states that chess-playing ability is unrelated to general intelligence. If this is so, good chess players would be found to have average intelligence levels. Hypothesis 2 states that chess-playing ability demands a high level of intelligence, and if this is so a high intelligence level would be found among good chess players as a necessary but not sufficient condition for acquiring the skills. Hypothesis 3 states that chess-playing ability requires a particular kind of intelligence, namely strong visuospatial abilities. This hypothesis is suggested by the analysis of chess-playing ability by Chase & Simon (1973). They argue that the major skill of the chess master lies in pattern recognition. There are in chess a number of advantageous patterns, e.g. forks, pins, a chain of pawns, castles commanding open vertical files, bishops commanding open diagonal files, and so forth. The good player has somewhere between 10000 and 100000 of those advantageous patterns stored in

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long-term visuospatial memory. Good play consists of visualizing how the present position on the chess board can be transformed by one or more moves into one of these advantageous patterns and selecting the best patterns from the numerous alternatives. This requires the mental manipulation of spatial patterns, and would require strong visuospatial ability.

Method

The subjects for this study were 33 young chess players who participated in a chess tournament in Belgium in 1989. Their mean age was 11.0 years and ranged from 8.10 to 13.2 years. There were four girls and 29 boys. The standard of play was high for children of this age. The standard of play at chess is measured by the Edo scale. This sets the mean of tournament players at 1500 with a standard deviation of 200. World champions achieve scores of around 2700. A useful description of this metric is given by Holding (1985) and more technical accounts by Edo (1978) and Batchelder & Bershad (1979). Players are classified as senior master (2400+), master (2200–2399), expert (2000–2199) and class A to E in 200 unit bands from 1000 (class E) to 1999 (class A).

The subjects of the present study had a mean Edo rating of 1450. All the children were players in recent all-Belgium chess championship tournaments and the best among them would be numbered among the top 25 players in the world in this age range.

The young chess players were tested with the French WISC (Wechsler Intelligence Scale for Children). This test is a French adaptation and standardization of the American test, which it closely resembles. The performance subtests and digit span are identical to the American test, but the other verbal subtests have some changes to make them more suitable for French and Belgian children. Verbal, performance and full-scale IQs are calculated in the same way as in the American test. All the children spoke French as their native language.

Results

The sample was broken into three groups of 11 each on the basis of their Edo ratings. Group 1 had a rating of 1550+, group 2 of 1350–1550, and group 3 of 1000–1350. The mean full-scale, verbal and performance IQs were calculated for the three groups separately and also for the total sample and the results are shown in Table 1.

Table 1. Mean IQs of young Belgian chess players

Group	*N*	Full-scale IQ	Verbal IQ	Performance IQ
1	11	122	110	131
2	11	123	110	132
3	11	117	107	124
Total	33	121	109	129

Considering the total sample, the most striking features of the results are the high mean full-scale IQ of 121 and the disparity between the verbal and performance IQs of 109 and 129 respectively. The mean full-scale IQ of 121 is clearly significantly higher than the population mean of 100. The range of full-scale IQs was from 107 to 136. The mean performance IQ of 129 is substantially higher than the mean verbal IQ of 109 and this difference is statistically significant at the 1 per cent level ($t =$

56.8). Considering the three subgroups, the strongest subgroup's mean IQs appear somewhat higher than the weakest. In the case of the performance IQ, the seven-IQ point disparity is statistically significant ($t = 3.09$, $p < .01$) but the differences for the full-scale and verbal IQs do not reach statistical significance.

Discussion

The results suggest that high-level chess playing requires good general intelligence and strong visuospatial abilities. A possible alternative explanation for the high visuospatial abilities of the sample might be that playing chess develops the visuospatial abilities of these children rather than the visuospatial abilities being a prerequisite for the acquisition of chess skills. Studies of the transfer of skills make this unlikely. For instance, Longstreth & Alcorn (1990) trained children on spatial games involving the assembly of coloured blocks into designs and could find no transfer effect to the performance subtests of the WPPSI. In a further study, it was found that prolonged training on the recall of digits had no transfer to the recall of letters (Ericsson, Chase & Faloon, 1980). We are therefore inclined to discount the possibility that playing chess increases general visuospatial ability.

The apparent requirement for strong visuospatial abilities for the acquisition of high-level chess skills may go some way towards explaining the predominance of males among chess grandmasters. In the early 1980s there were no women among the top 300 world class players (Hartston & Wason, 1983). Linn & Petersen (1986, p. 74) in a recent review of the literature conclude that sex differences in spatial ability range from one-third of a standard deviation to almost a full standard deviation, depending on the tests used and the particular kind of spatial ability. Where the sexes differ by one third of a standard deviation (five IQ points) there will be 48 males to 22 females at a spatial IQ of 130 (approximately two per 100 individuals) and approximately four males to one female at a spatial IQ of 145 (approximately one individual per 1000). Where the sexes differ by a full standard deviation, there will be approximately eight males to one female at an IQ of 130 and approximately 20 males to one female at an IQ of 145.

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