# Classifying Player's Expertise Level in Chess by Analysing Gaze Data

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## Objective

To analyse the gaze data of participants in a "Find the best move task" and use their fixation on different region of the chessboard to classify their competency in playing chess.

## Previous Studies

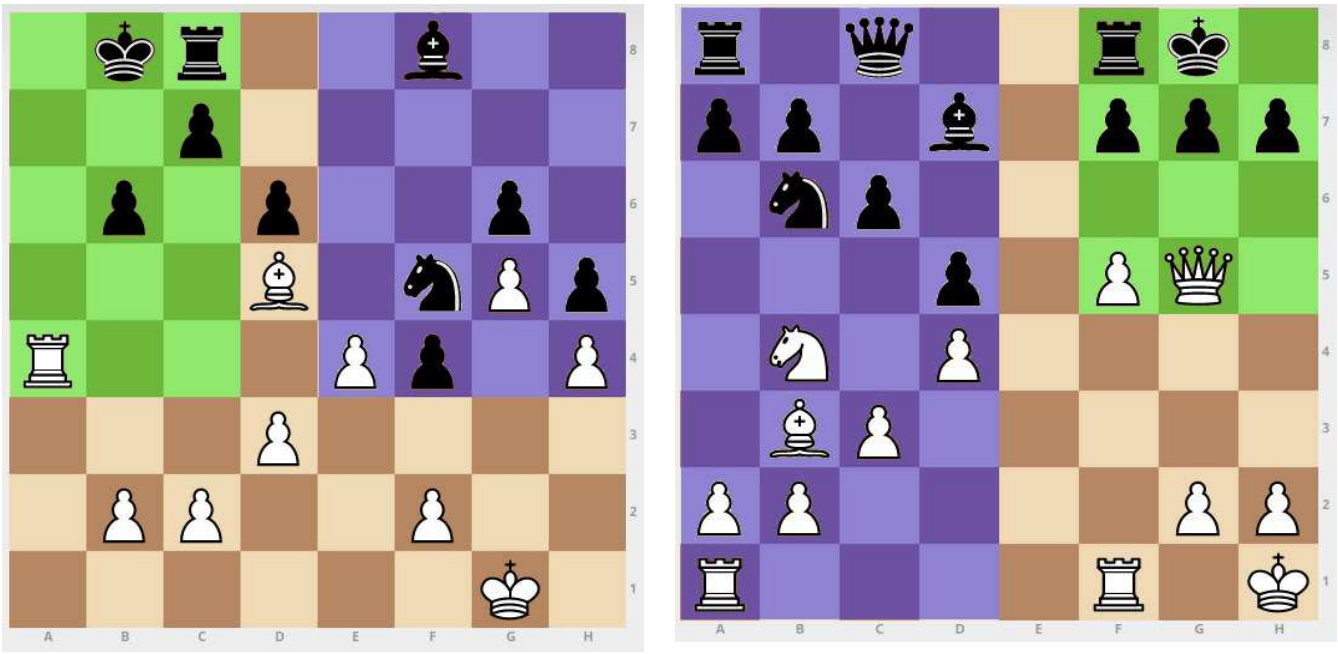
Studies (Sheridan, H., & Reingold, E. M. (2014)) have shown that experts can rapidly distinguish between the relevant / irrelevant chessboard regions to find the best move in a given chess situation faster than novices.

## Method

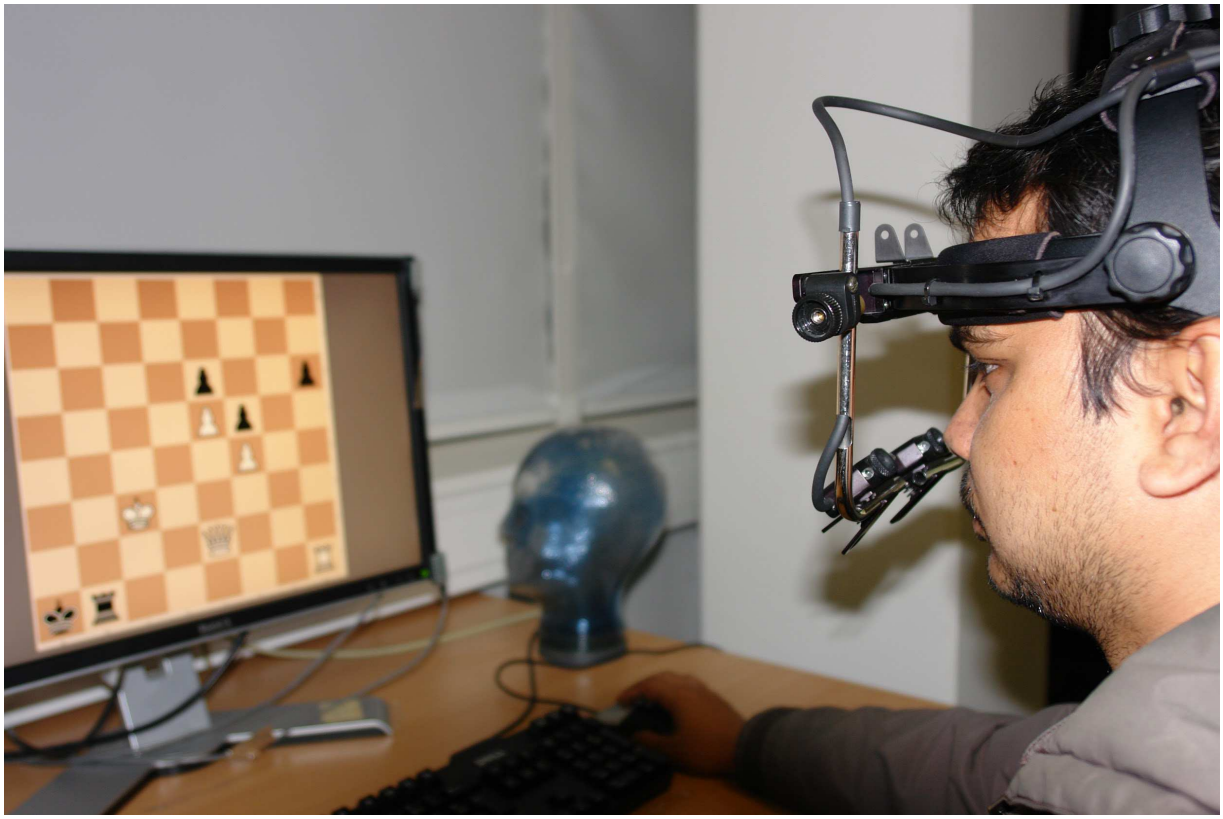
Chess problems(designed with the help of a chess expert) will be shown to the participants which include a partition into relevant / irrelevant regions for the game situation. The time taken by the participants to fixate on the relevant and irrelevant region while solving the problem will be measured and compared to the performance of an expert while solving the same problem.

## Experiment Design

We used 12 experimental problems that had been designed with the help of a chess expert. The relevant and irrelevant regions in a problem were always separated (The relevant regions are highlighted in green and irrelevant regions are highlighted in blue).
Each participant was shown problems (on a screen for better calibration of the eye-tracking glasses) and was given 3 minutes per problem to choose the best possible move for the white player as quickly as possible.
Participants have told their response to the tester orally.
An expert's response has been recorded to be used as a benchmark for comparing the skill sets of the participants.



**Sample Chess Problem (green=relevant area, blue=irrelevant area)**



**Experiment Setup**

## Analysis

To create a measure for the participants' skill we first calculated the ratio (**Ratio Fix**) of time spent on fixations in the relevant regions to time spent on fixations in the irrelevant regions (experts tend to spent more time fixating on the relevant regions).

We also evaluated the **cp** (centi pawns) score of the answers given by the participants using the chess engine Stockfish (the better the move the higher the cp score will be). An arbitrary cp value of 1000 is used for the best move, because Stockfish does not give cp values for moves resulting in mate in less than 5 moves. Instead it will show mate in 2 or mate in 3 moves.

To normalize the ratio (**Ratio Fix** = Time spent fixating in relevant areas / Time spent fixating in irrelevant areas) for different participants we have divided the **Ratio Fix** by the total time taken (**Response Time**) to solve the problem.

Finally the overall Skill Index was calculated as follows:

**Skill Index** = **cp *(Ratio Fix /Response Time)**

## Classification

The players were classified into 3 categories as follows:

**Expert** - If the Skill Index of the participant deviates from the Skill Index of our benchmark expert only by 0 - 15 %.

**Skilled/Good** - If the Skill Index of the participant deviates from the Skill Index of our benchmark expert only by 15 - 30 %.

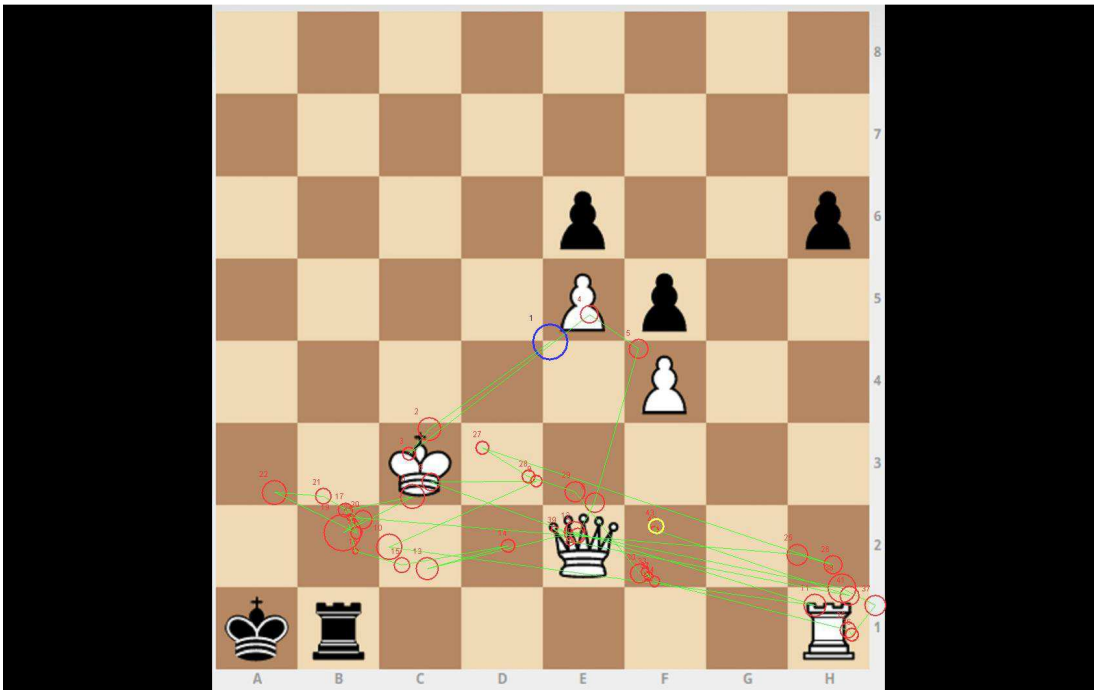
**Novice** - If the Skill Index of the participant deviates from the Skill Index of our benchmark expert by more than 30 %.

## Experiment Results

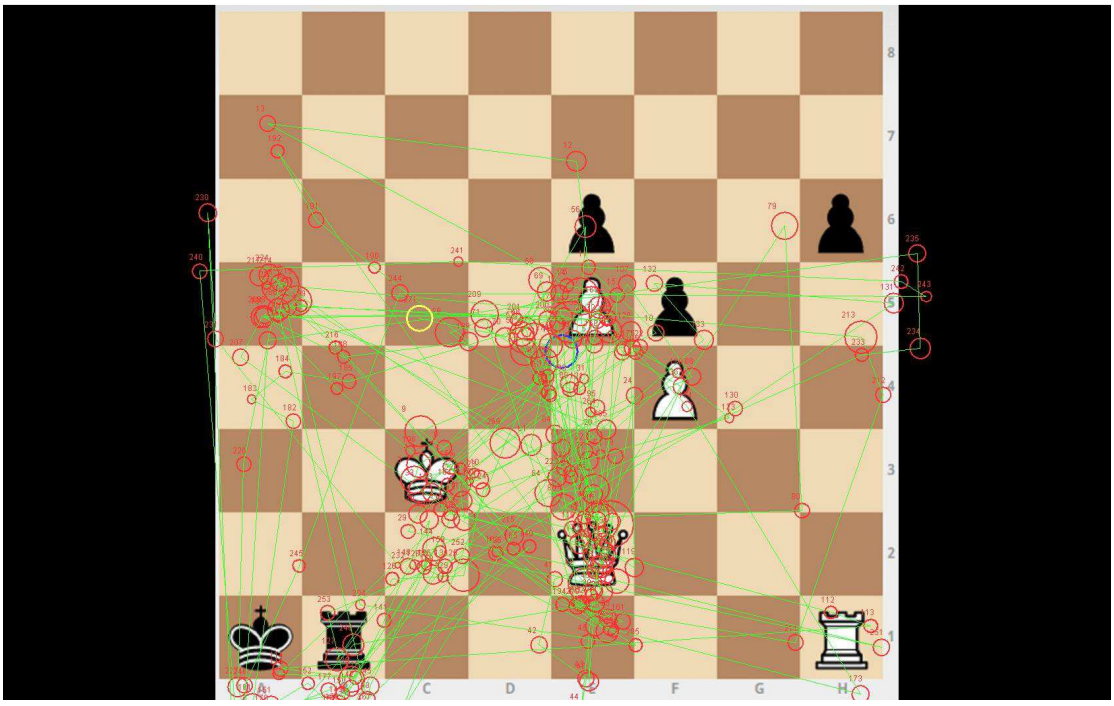
We have conducted the experiment with 12 random participants. Data from 2 participants could not be used for the analysis because the application crashed in the middle of experiment in one case and in the other there was a problem with calibrating the eye-tracking device because the participant wore glasses. **One puzzle (Hard1) was so tricky that only 1 participant got it right. Data of this puzzle was also excluded from the calculations.**

Out of 10 successful participants only 1 was classified as **Good** and the rest as **Novice.**

| | Skill Index | % difference (wrt Expert) | Classification |
|---|---|---|---|
| Expert (Benchmark) | 11621.21043 | | |
| P1 | 516.3239727 | 95.58968249 | Novice |
| P2 | 433.1574686 | 96.30007114 | Novice |
| P3 | 2995.459518 | 74.4134918 | Novice |
| P4 | 1632.21282 | 86.05802334 | Novice |
| P5 | 8135.06607 | 30.51218571 | Good |
| P6 | 274.9184225 | 97.65171172 | Novice |
| P7 | 751.8960785 | 93.57748116 | Novice |
| P8 | 78.57444021 | 99.32883568 | Novice |
| P9 | 446.7138853 | 96.18427543 | Novice |
| P10 | 2918.826899 | 75.06806955 | Novice |



**Expert’s Gaze data (Most of the fixation points in relevant area)**



**Novice’s Gaze Data (Fixation points dwell all over the board)**

**General Observations**

We have recorded other general information about the participant such as:

| How would you rate your chess skills? | When was the last time you played chess? | Have you ever worn an eye-tracking device? |
|---|---|---|
| Expert - 1 | Last week - 3 | Yes - 7 |
| Good - 7 | Last Month - 1 | No - 5 |
| Novice/Beginner - 3 | Last Year - 4 | -- |
| Can't Say - 1 | Can't Remember - 4 | -- |

Only one of the 12 participants was a woman which shows that the game is not really popular amongst women. Another general trend can be observed here that people usually tend to rate their sporting skills really high.

## Future Work

None of the participant in the study plays chess professionally or is associated with any chess club. In the future we could include professional players and more participants to get varying results.

Another interesting application could be to identify the fixation area of an expert player in a fast paced game such as Table Tennis. It would be interesting to find out whether experts focus on the ball or the hand (Bat) of the opponent during fast rallies. Results could help in improving training scenarios.