

What does research into chess expertise tell us about education?

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Overview of the Talk

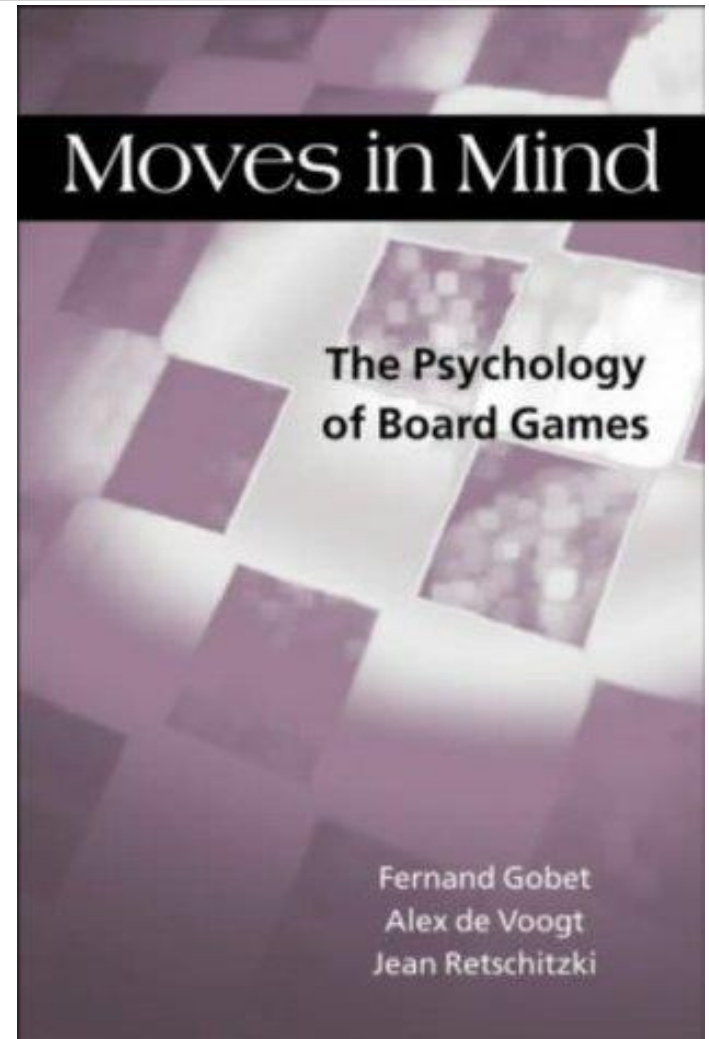
- Psychological research into expertise: Key findings
 - Perception
 - Memory
 - Problem solving and decision making
- The making of a chess master: Nature or nurture?
- Can psychological research inform the development of coaching methods in chess?
- Do the skills acquired in chess transfer to other domains, such as language and mathematics?



If you want all the details...

Papers on line:

[http://people.brunel.ac.uk/~hsstffg/
bibliography-by-topic.html#Expertise](http://people.brunel.ac.uk/~hsstffg/bibliography-by-topic.html#Expertise)

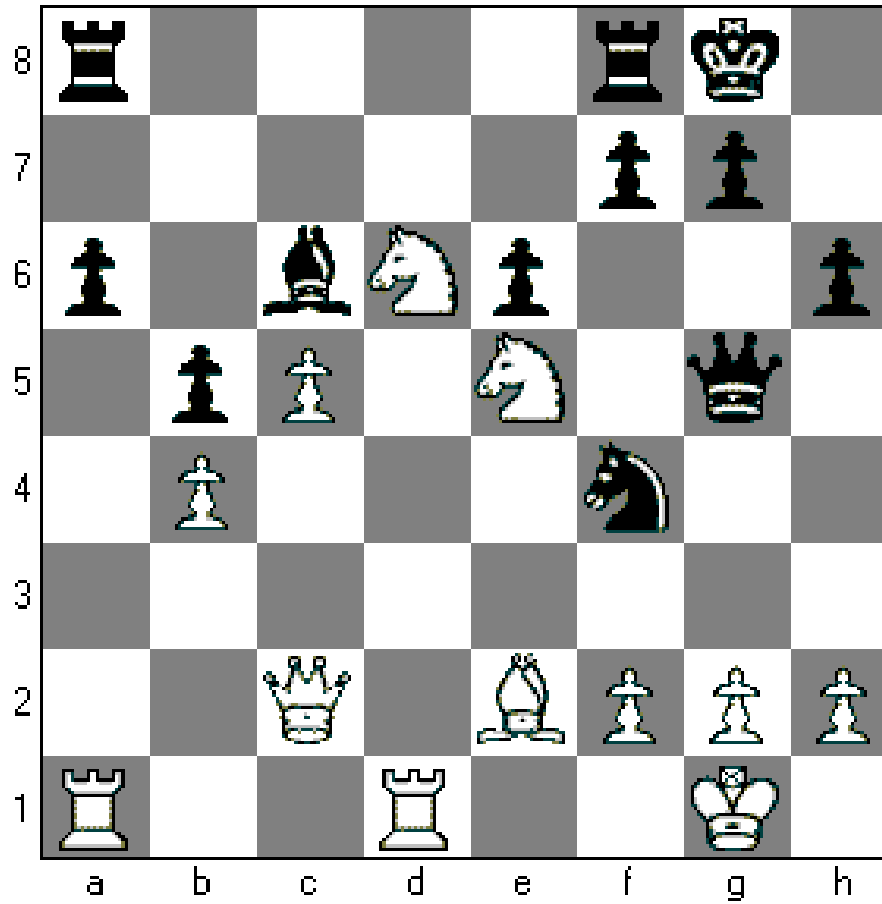


Psychology Press, 2004



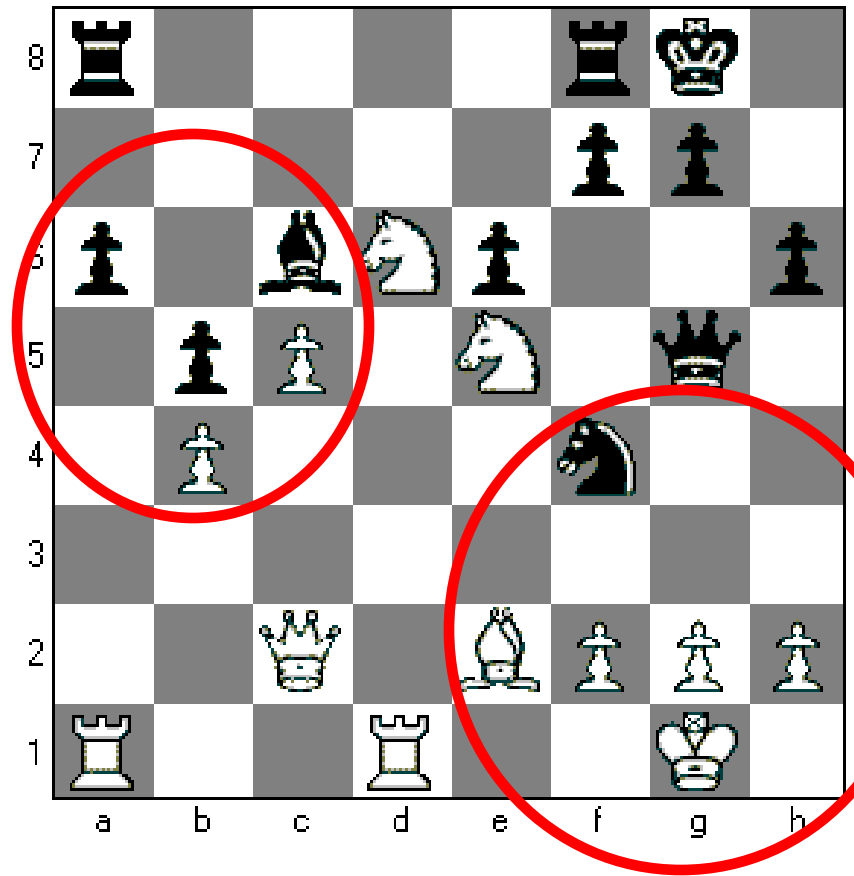
Adriaan De Groot

- *Thought and Choice in Chess* (1946)
- Compared top-level grandmasters with candidate masters
- Asked the players to think aloud when preparing their next move
- No systematic differences in the structure of search
 - About the same number of positions searched
 - About the same depth of search
 - All players show a highly selective search
- Grandmasters “see” the problem differently

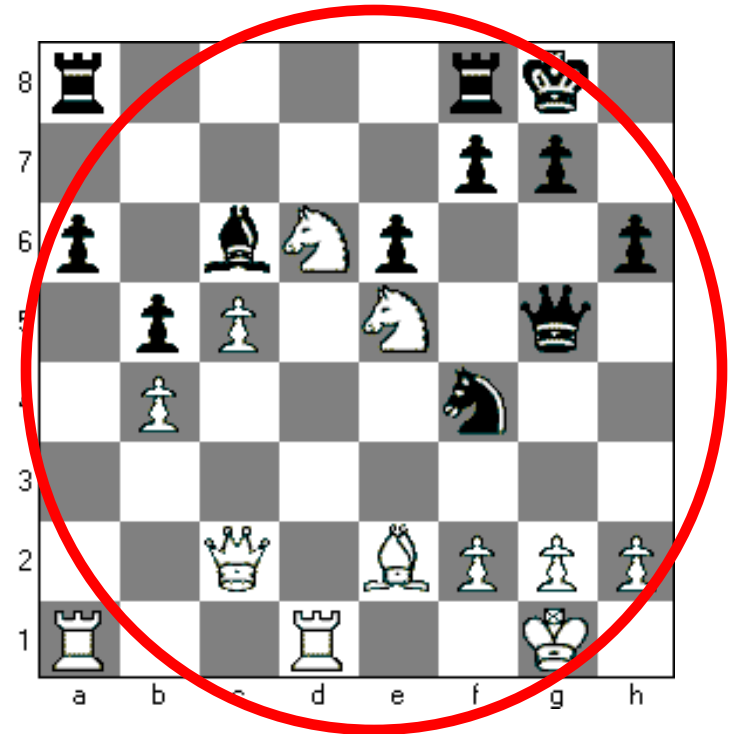
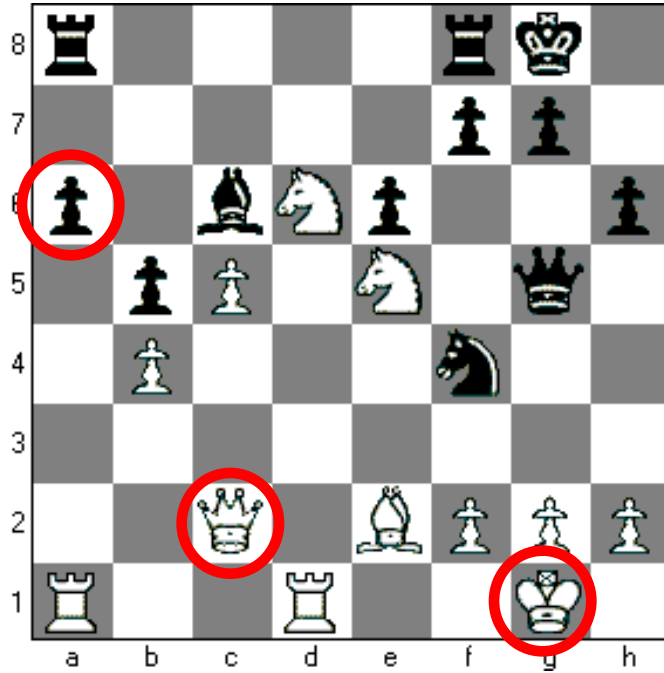


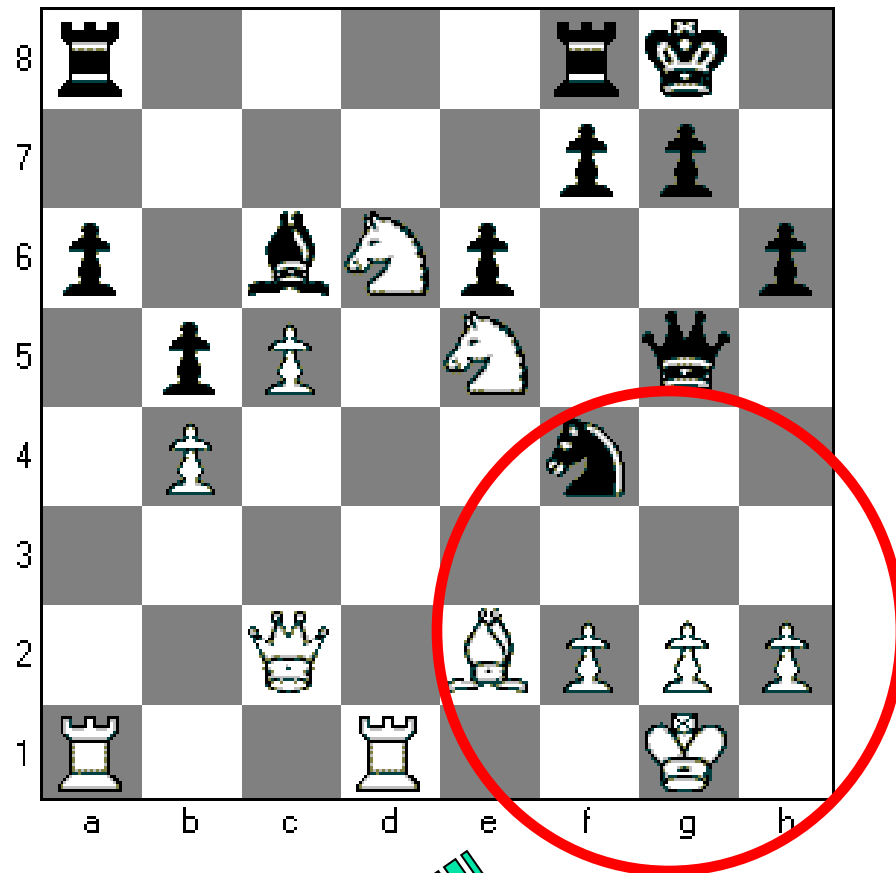
Chase and Simon's (1973) Chunking Theory

- Information in memory is stored as 'chunks'
- A chunk is a familiar pattern that can be used as a unit
- Masters have about 100,000 chunks
- Chunks can be recognized instantly
- It takes about 10 seconds to create a chunk

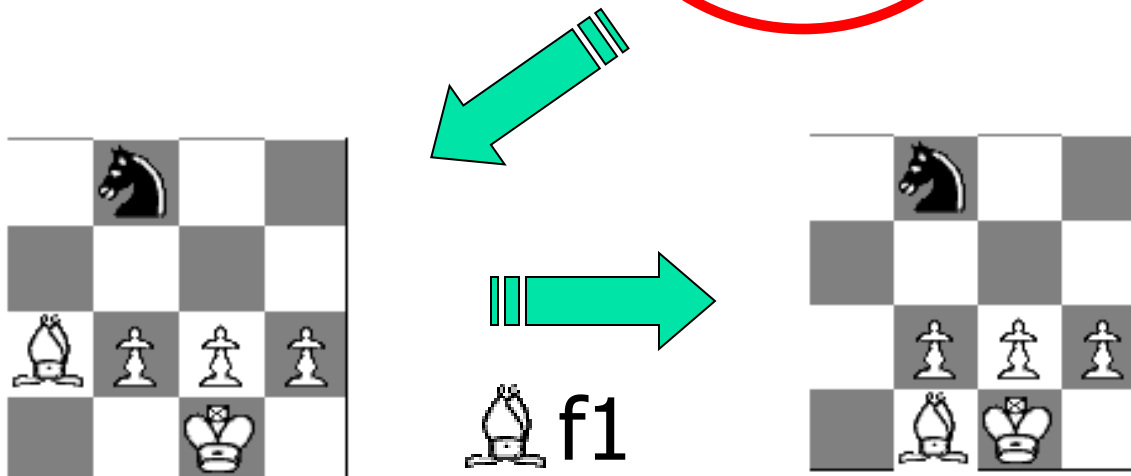


Perceptual Chunks: From Novice to Grandmaster





- Chunks are linked to possible actions
- In chess: identification of weaknesses, moves, plans



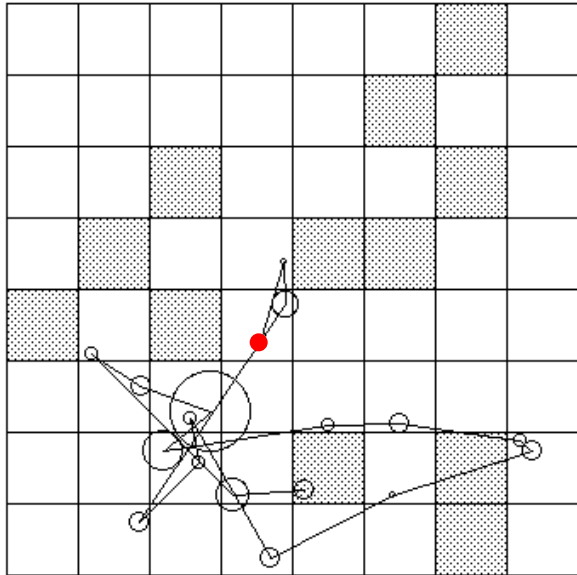
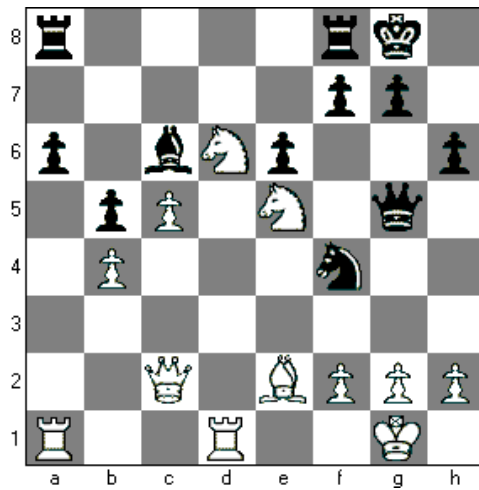


Perception

Recording Eye Movements (De Groot & Gobet, 1996)

- Eye movements recorded during the first 5 seconds in a recall task
- Clear differences between masters and novices
- Experts' fixations are faster
- Experts look at the key features of the situation more rapidly



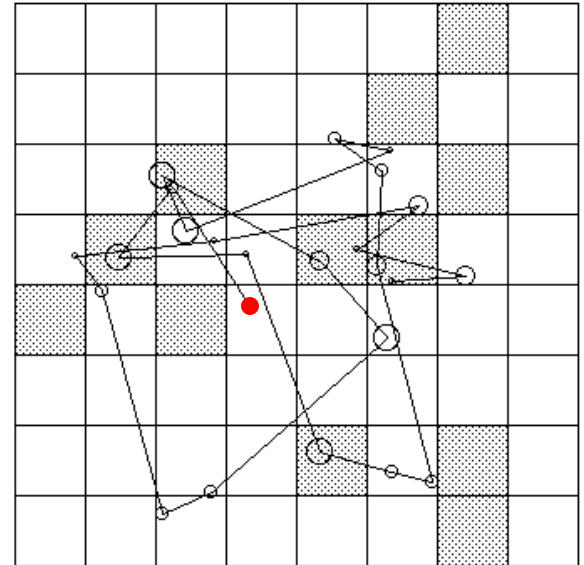


Novice

310 msec
140 msec

Fixation duration

mean
sd



Master

260 msec
100 msec

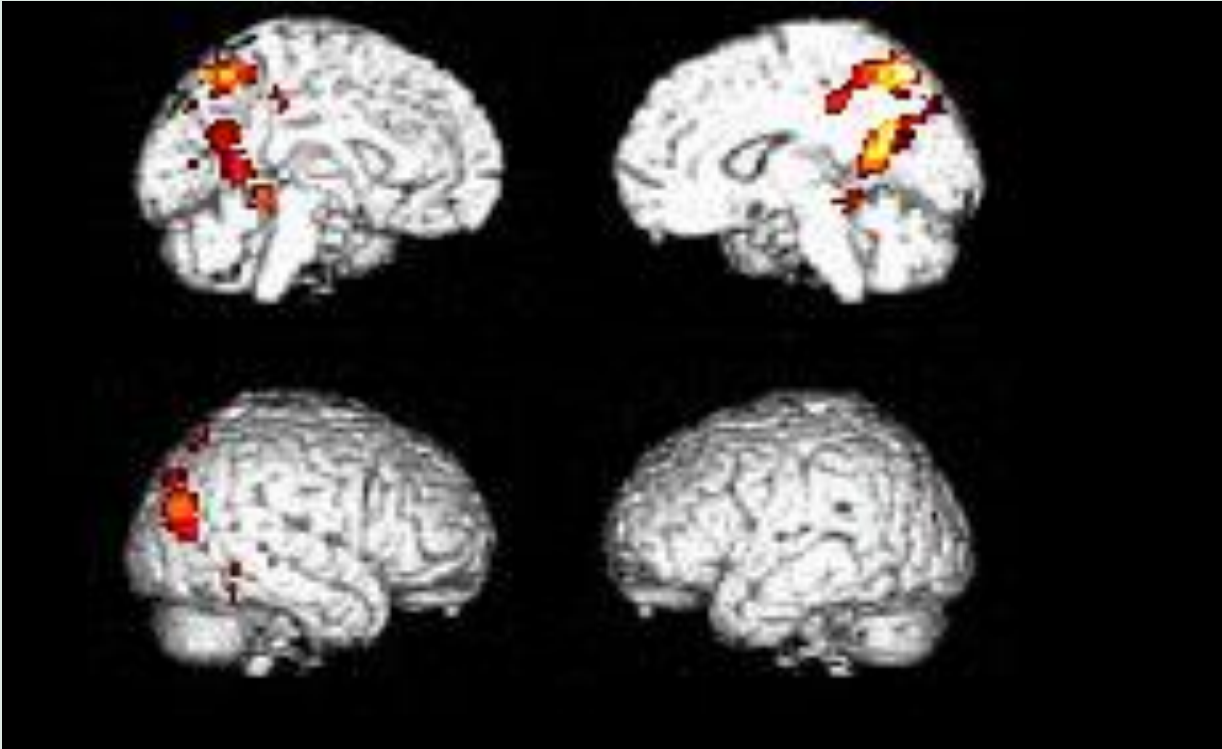


Memory

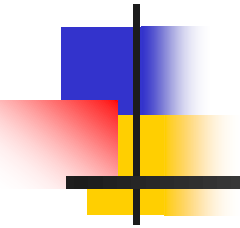


Experts' Memory

- Chess results generalize to almost all domains of expertise
 - Experts show a remarkable, automatic memory for their domain material
 - Even without intention of memorizing anything!
- Experts' perceptual knowledge may explain the phenomenon of 'intuition'
- Experts have very specialized knowledge, partly coded as *chunks*
 - This leads to difficulties in transfer



Problem Solving and Decision Making





Evidence for Pattern Recognition

- Kasparov's simultaneous exhibitions
 - Played against national teams (4 to 8 masters and grandmasters)
 - His rating is only slightly lower than under tournament conditions: 2750 vs. 2646 Elo points
- Campitelli and Gobet (2005) asked players to choose a move within 10 seconds
 - Grandmaster about 50% correct
 - Strong club players about 5% correct
- Similar results in domains such as medical diagnosis or physics



Evidence for Search

- De Groot (1946) did not find any skill difference in depth of search
- Later studies have found such differences
- Campitelli and Gobet (2004) used complex positions (maximum 30 minutes)
 - The values for the search variables were much higher than in previous studies
 - Maximal depth of search was 25 ply vs. 7 ply for the grandmasters in De Groot (1946)



Pattern Recognition and Search Summary

- Experts show a highly *selective search*
 - They ‘see’ the solution
 - Experts often cannot verbalize the way they solve a problem. They do it ‘intuitively’
 - This is presumably made possible by perceptual chunks
- In routine problems, experts do not search much more than non-experts
- When necessary, they can search to great depths



Nature or Nurture?



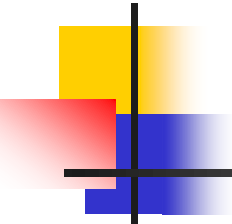
Mainstream View in Expertise Research

- Experts typically
 - do not have a higher general intelligence or a special talent
 - show the same cognitive limits as novices
- It takes about 10 years to become an expert
- Expertise is acquired through deliberate practice
 - Ericsson's extreme view: Deliberate practice is sufficient for acquiring expertise



What do the Chess Data Say?

- The role of practice is well established
 - Biographies of grandmasters
 - Questionnaires show that it takes on average 11,000 hours of practice to get master level (e.g., Gobet & Campitelli, 2007)
- Huge variability in the amount of practice
 - Some chess players took 8 times longer than others to become Masters (e.g., Gobet & Campitelli, 2007)
- Players are quicker to become a grandmaster nowadays than fifty years ago:
 - Fischer attained his first grandmaster (GM) result 9 years after he started playing chess
 - Magnus Carlsen took about 6 years to obtain the GM title

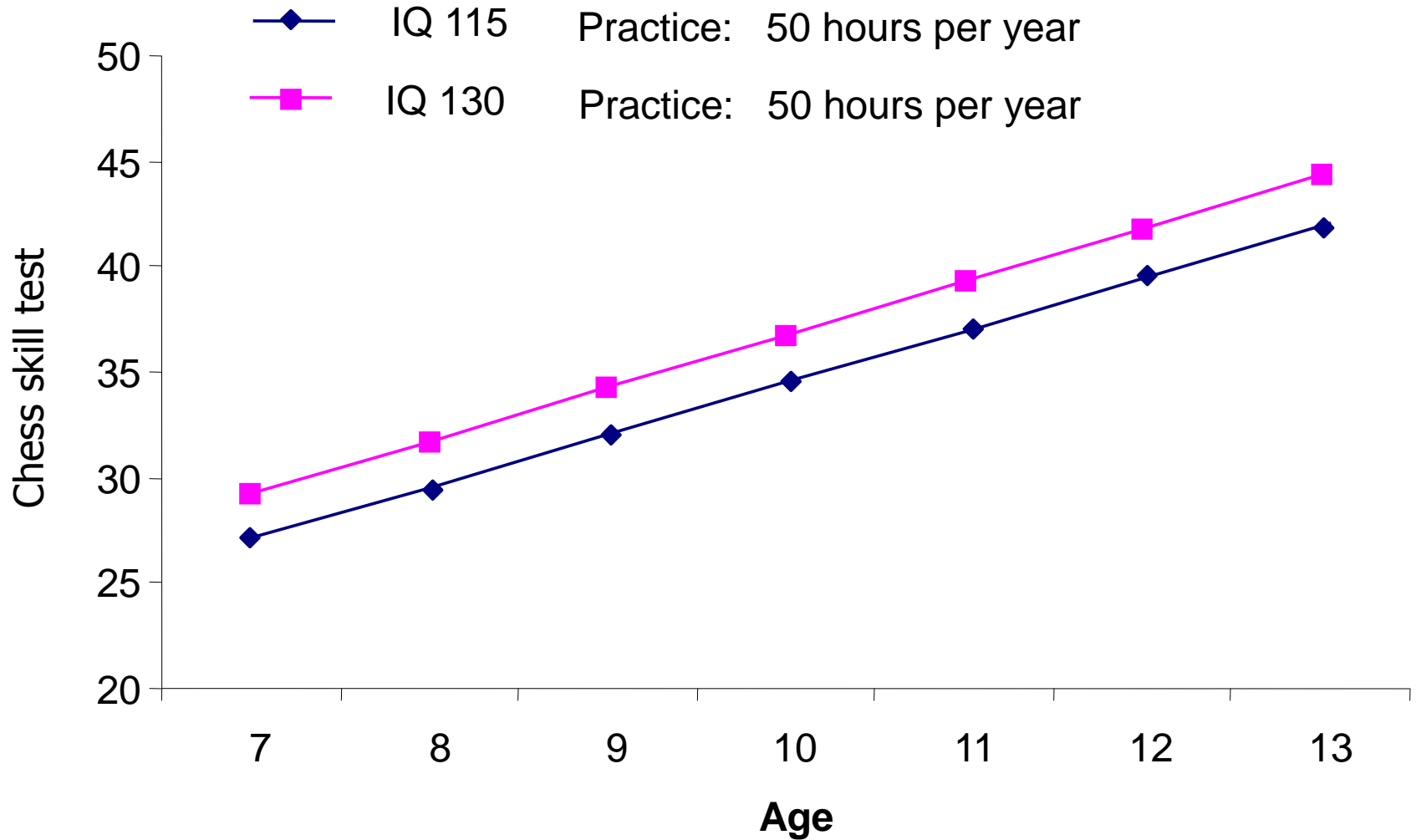
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- Few data directly supporting the role of talent
 - Chess players tend to be more often non-righthanded than the population (e.g., Gobet & Campitelli, 2007)
 - 18% vs. 10.2%
 - Chess players in the north hemisphere tend to be more often in late winter and early spring (Chassy & Gobet, 2007)
 - 56.9% vs. 43.1% for players above 2500 Elo
 - The data using intelligence tests are inconclusive
 - Interestingly, chessplayers are not particularly good in visuo-spatial tasks (Waters et al., 2002)



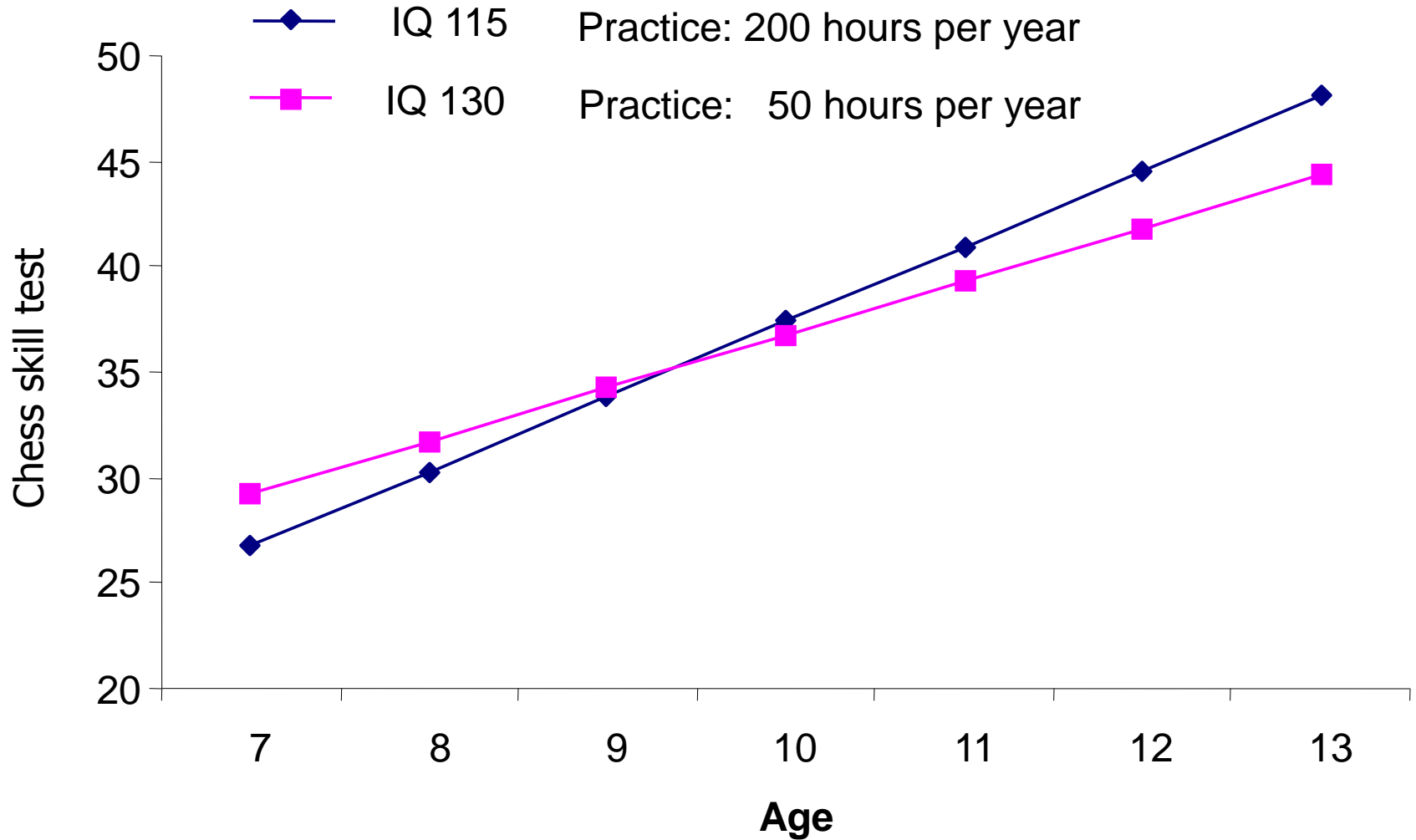
A Longitudinal Study (Bilalić et al., in prep.)

- 66 children who had just begun to play chess
- Followed for two years and a half
- Repeated measures on
 - Chess skill
 - Motivation
 - Intelligence
 - Amount of practice
 - Personality
- The results suggest that
 - in the earlier stages, there is a strong relationship between intelligence and skill
 - in later stages, this relationship is mediated by the amount of practice and interest

The Role of Intelligence in Skill Acquisition



The Role of Intelligence in Skill Acquisition





Training and Coaching



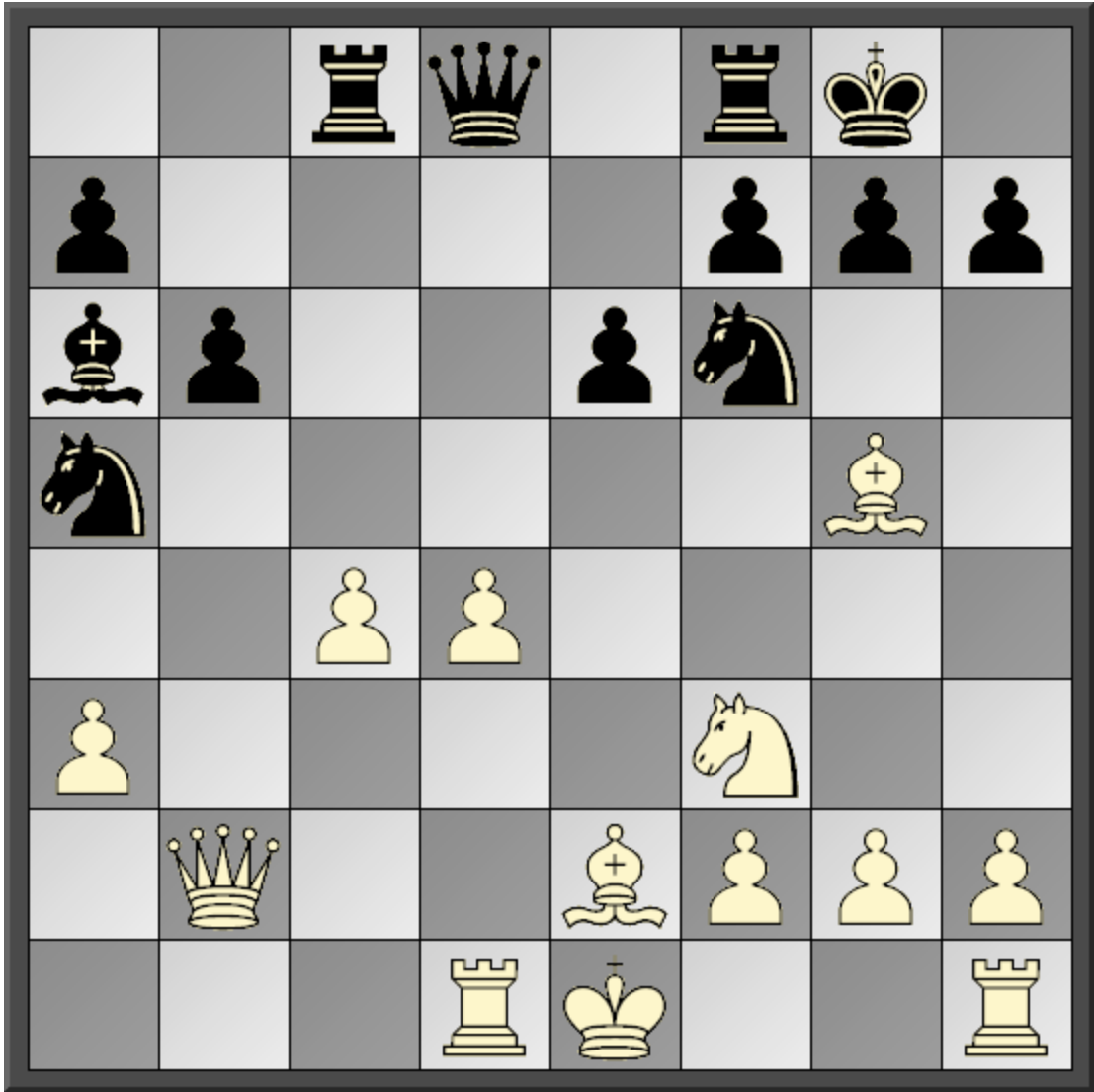
Training Methods (I)

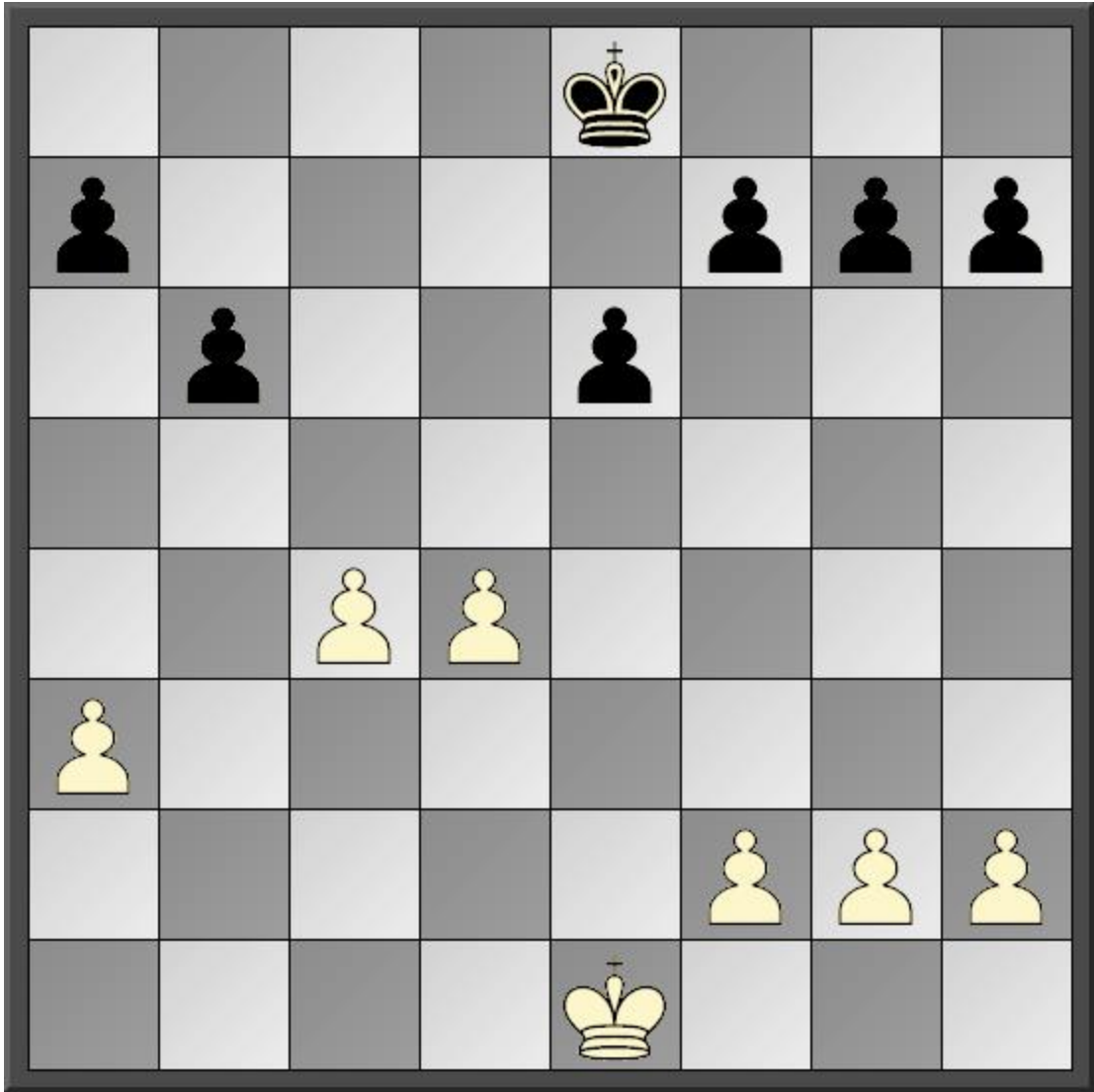
- There is good evidence that players get better quicker than in the past
- This is likely due to availability of
 - World-class computer programs
 - Databases of games
- This would be an unexpected indirect support for the role of pattern recognition in chess
- Not clear whether the quality of the chess literature or instruction methods has improved
 - The methods of the Soviet School are still be seen as the best

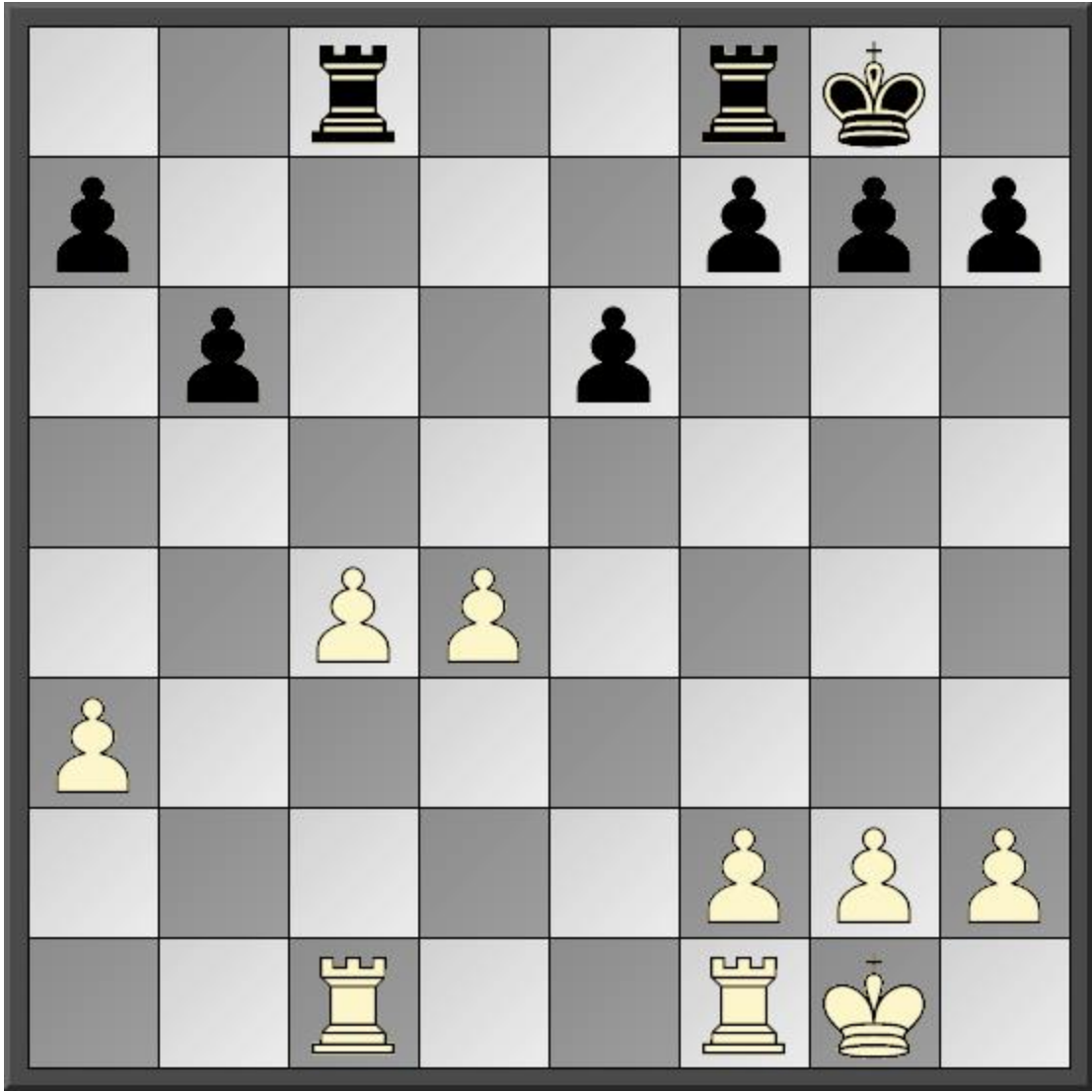


Training Methods (II)

- Few training methods in chess are based on scientific research into education and learning
- Gobet and Jansen (2006) derived three principles derived from research into (chess) psychology
 - Teaching should move from simple to complex
 - Elements to learn should be clearly identified
 - Learning is facilitated by following an ‘improving spiral’ method, where key information is presented several times with increasing complexity
- Doubts about methods aiming at
 - Training imagination and short-term memory *per se*
 - Focusing on improving look-ahead search
 - Increasing mental imagery with blindfold chess
- Gobet and Jansen’s views still await empirical test









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The Question of Transfer



A Review of Literature

(Gobet & Campitelli, 2006)

- Do skills acquired with chess transfer to other domains (e.g., maths, English)?
- Study commissioned by Prof Tim Redman for the Education and Chess conference (2001)
- Three criteria for selecting studies
 - Presence of an empirical investigation
 - Objective measure of the potential effect(s)
 - Presence of enough detail to evaluate the methodology used and the results obtained
- Only six studies met these criteria



Studying Transfer: The Ideal Experiment

- Participants randomly allocated to
 - One or several treatment groups
 - Two control groups
 - one placebo group
 - one no-treatment group
- Measurements are taken
 - Before the experimental manipulation (pretest)
 - After (posttest)
- Both participants and experimenters are blind
 - To the goal of the experiment
 - To the fact that they belong to an experiment



Results

- The Ideal Experiment is difficult to carry out
 - But without it it is difficult to reach conclusions about the benefits of chess teaching beyond chess
- Only three studies randomly assigned participants to the chess treatment group
 - Christiaen & Verhofstadt-Denève (1981)
 - Frank & d'Hondt (1979)
 - Fried & Ginsburg (undated)
- In these studies, there was not strong support for the hypothesis of transfer
- The other three studies used experimental designs too weak to infer causal relations



Conclusions of the Study (I)

- The results only weakly support the hypothesis of transfer from chess instruction
 - Little evidence for increase in intelligence, creativity, and school performance
 - This is in line with what is known about transfer in psychology
- Chess instruction may be beneficial at the beginning
 - Improvement in concentration
 - Learning to lose
 - Interest for school in underprivileged environments



Conclusions of the Study (II)

- The benefits seem to decrease as chess skill improves
 - Amount of practice necessary
 - Specificity of the knowledge that is acquired
- Compulsory instruction may not be recommended, as it seems to lead to motivational problems
- Many studies used a weak experimental design
 - Hopefully better studies will be presented at this Conference!



Summary

- Key role of perception and knowledge in chess expertise
- Deliberate practice is necessary, but not sufficient to reach top levels of expertise
- Individual differences play a key role mainly in the early stages of expertise
- Efficient methods have been developed for chess coaching
- Whether skills acquired with chess transfer to other domains is unclear at this stage



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- Andrew Waters