Chess instruction in schools: A quantitative review

3/31/2016 – Does chess in school make children smarter? In this review of the available evidence, Giovanni Sala and Fernand Gobet show that chess instruction in schools provides some moderate effects, especially in boosting children's cognitive and mathematical skills. Ultimately, it is shown that while providing measurable benefits, the more one studies the greater the results.

Chess instruction in schools: A quantitative review

by Giovanni Sala and Fernand Gobet

There has been recently much interest and research on the possible cognitive and educational benefits of teaching chess. Chess is now part of the school curriculum (as an optional subject) in several countries and research on the educational effects of chess instruction is currently carried in the United Kingdom, Spain, Turkey, Germany and Italy. The European Parliament and the Spanish Parliament have supported the use of chess instruction in schools as an educational tool.

The explicit assumption behind these initiatives is that skills acquired through chess instruction transfer to other fields: They improve mathematical and reading skills, and they enhance general cognitive abilities such as concentration and intelligence. Is this assumption supported by the empirical evidence?

Ten years ago, Gobet and Campitelli (2006) reviewed the studies having researched the effects of chess instruction on youngsters' academic and cognitive abilities. Three important points were highlighted in their conclusions. First, the available experimental evidence was sparse (just seven studies in thirty years, with only two published in peer-reviewed journals). Second, the conclusions of the studies reporting positive findings on the effectiveness of chess instruction were limited by the typically poor methodology used. Last but not least, the available research provided no explicit causal model explaining *why* chess should foster students' academic skills. In fact, substantial research in educational psychology and the psychology of expertise strongly suggests that transfer of skills from a domain (e.g. chess) to another one (e.g. mathematics) is difficult and occurs only when there is an overlap between the source and the target domains (see Gobet, 2015, for a recent discussion). Thus, Gobet and Campitelli had to conclude that the educational benefits of chess instruction were not supported empirically and that they were not justified theoretically.

Today, research on the effects of chess instruction is healthier. There are more studies (between 30 and 40, depending on the selection criteria) and, in general, the methodological quality has improved. This is reflected by the fact that more studies have been published in peer-reviewed journals (ten since 2006). In addition, several explanations trying to account for the potential educational benefits of chess instructions have been provided. For example, chess practice may foster some general cognitive skills, such as executive functions, meta-cognition and general intelligence, which in turn improve students‘ academic performance. Alternatively, chess might promote some academic skill, such as mathematics, because it shares several elements with the target domain (e.g. the value of the pieces and basic arithmetic, the movement of the pieces and geometry).

Chess instruction in schools is on the rise, but are the benefits scientifically justified?

We therefore decided that it was time to carry out a rigorous, quantitative review of the available evidence. To do so, we used the most appropriate method: Meta-analysis (e.g. Schmidt & Hunter, 2015). Meta-analysis is a statistical procedure that allows one to merge the results of many studies regarding a

particular topic – in our case, the benefits of chess instruction on educational outcomes – into a single quantitative measure representing the size of the overall effect of one variable (chess instruction) on another variable (educational outcomes). In education, effect sizes typically consist of the standardized difference in improvement between a treatment group and a controlled group.

One advantage of using meta-analysis is that it is possible to compare the effect size of chess instruction with other school interventions. In a seminal book, Hattie (2009) carried out a synthesis of more than 800 meta-analyses of studies having investigated educational interventions. The outcome was that most school interventions show a positive effect. In fact, 50% of educational interventions have an effect of at least 0.40, a result that can often be obtained by traditional didactics. Thus, to be convincing and offer real educational advantages, a study should obtain an effect size higher than 0.40 – what Hattie calls the "zone of desired effects."

We collected all the studies assessing the effectiveness of chess instruction in improving academic (mathematics and reading) and cognitive skills (e.g. intelligence, focused attention, meta-cognition). Then, we calculated (a) an overall meta-analytic mean and (b) three meta-analytic means, one for cognitive-related skills, one for mathematical-related skills and one for reading-related skills. The studies had to meet precise inclusion criteria, such as reporting an intervention (no correlational study was incorporated) and including, at least, one control group. The criteria were satisfied by 24 studies, with a total of 5,221 participants (2,788 in the experimental groups and 2,433 in the control groups) and altogether 40 effect sizes. The number of effect sizes is larger than the number of studies because some studies included different measures (e.g. reading skill and mathematical ability), and thus more than one effect size.

The overall effect size was 0.34, indicating a moderate positive overall effect of chess instruction. More specifically, the effect sizes were 0.38 for mathematics, 0.33 for cognitive skills, and 0.25 for reading (see Figure 1). Finally, the analysis showed a direct relation between the duration of the chess intervention and the magnitude of the effect. When considering only the studies with more than 25 hours of chess instruction, the effect size was 0.43. (All these effects were statistically reliable, with $p < .05$ or less).

Figure 1. Histogram of the overall effect sizes in cognitive, mathematics, and reading skills.

Chess instruction seems to have a positive effect on children's cognitive and academic (especially mathematics) skills, but the effect is no more than moderate. This outcome may be important for the study of transfer of skills in psychology, but it sheds some doubts about the usefulness of chess as an educational tool. In fact, given that the median effect size of interventions in educational contexts is 0.40, there are many (more than 50%) better ways to improve children's skills than chess instruction. Moreover, nearly all the reviewed studies lack a *do-other* control group, and thus it is impossible to rule out the presence of confounding variables such as placebo effects, for example teacher's motivation, teacher's expectation and student's enthusiasm induced by a novel activity.

However, the fact that the duration of chess instruction positively correlates with the size of the effects is an encouraging result. If the benefits of chess instruction were merely due to placebo effects, these effects would probably occur regardless of duration. This is because the occurrence of placebo effects depends on the participation in the activity, not on the circumstantial features of the activity. A concrete possibility is thus that chess instruction requires a certain minimum amount of time (about 25-30 hours) to show appreciable effects (above 0.40). Nonetheless, the lack of control for placebo effects is still a severe limitation in this field of research.

*It is perhaps not surprising that chess is much like anything: you reap what you sow. The more time and effort invested, the greater the rewards, just as going to the gym will not magically make one fit, one must also sweat and strain. Still, the important takeway is that a serious time investment *will* yield palpable results.*

In conclusion, our meta-analysis upheld the idea that chess instruction improves children's cognitive and academic skills, but also raised doubt about the real effectiveness of such practice. Also, as pointed out above, it is not only a matter of *if*, but also of *how much* chess instruction enhances children's skills. Therefore, future studies should (a) control for potential placebo effects; (b) systematically vary the length of instruction to find what the optimal duration is; and (c) evaluate whether chess instruction can offer educational advantages compared to other interventions, such as music, checkers and Go.

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About the authors

Giovanni Sala is a PhD candidate in Psychology at the University of Liverpool. He obtained a Bachelor in Philosophy of Science and a Master in Cognitive Sciences at the University of Milan. Sala's research focuses on the psychology of expertise and educational psychology. His main interests are transfer of skills, experts' memory and intelligence.

Fernand Gobet is Professor of Decision Making and Expertise at the University of Liverpool. He spent his first career as a chess player, playing for the Swiss national team and earning the title of an International Master. He then moved to a scientific career, receiving his PhD in psychology in 1992 from the University of Fribourg (Switzerland). He held research and academic positions at Carnegie Mellon University (Pittsburgh), the University of Nottingham and Brunel University (London) before taking a chair at the University of Liverpool. His numerous collaborators include Nobel Prize winning Herbert Simon (one of the founders of Artificial Intelligence) and Adriaan De Groot (the father of chess psychology). Gobet has extensively written on expertise, the acquisition of language and computer modelling. His latest book *Understanding Expertise* (2015, Palgrave/Macmillan), provides a multi-disciplinary study of the psychology, sociology, neuroscience and philosophy of expertise, with extensive references to chess research.

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Beat the Slav the classical way

The Slav has become one of the most popular defences against the advance of the d-pawn on the first move, and every ambitious d4-player faces the question how to successfully tackle this opening in tournament practice. The strongest attempt is considered to be the move 4. Nf3, leading to interesting positions which promise White good chances to get an advantage. Black's main replies are 4. dxc4 and 4. e6. On this DVD Rustam Kasimdzhanov investigates in detail the line 4. dxc4, in which he has great experience. Showing selected grandmaster games, the ex-world champion shares his knowledge with the viewer to explain how White has to place his pieces and which plans he has at his disposal.Learn the secrets of the dxc4-line and improve your chances of success with 1.d4

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grandmastermac 4/2/2016 08:24
Out of interest, was the study "Mathematical Problem-Solving Abilities and Chess: An Experimental Study on Young Pupils" dated July 2015 also conducted by Giovanni Sala included in the meta analysis detailed above?

Beanie 4/2/2016 03:29
The sentence that begins, "In conclusion...." seems to contradict itself. Can anyone explain this to me?

PurpleUnicorns 4/1/2016 12:05
This looks so much better done and interesting than the joke of a paper focusing on gender differences and aesthetics that CB posted last week.

The figure I'm most interested in is the 25 hours, is that per semester or per year? I imagine 25 hours over the span of a semester is much more efficient than just pounding in 25 hours in 4 days for example.

A7fecd1676b88 4/1/2016 06:44
@isledoc: The modern version is "lies, damned lies, statistics, and psychological studies."

The Reproducibility Project, as is well known, recently showed that over half of psychological studies (and they were peer reviewed) were not reproducible.

Magnus, who is a sample size of one, stated that his playing in tournaments kept him away from school, so clearly chess did have a minor negative effect on him. But we can increase that sample size by studying the bios of other grandmasters. If memory serves, Tal, Spassky, and Kasparov studied easy subjects in University so they would have more time for chess. The Polgar sisters were home schooled, with chess the main subject being taught for eight hours. Of course they would have learned more math if they had not done chess. So chess hurt a little bit in the sense it took time away from some of their studies.

But nobody is worried about the Tals, Spasskys, and Polgars. They are smart and will succeed regardless as long as they have an interest in school. Fischer had no interest in school, and though he had a very high IQ, he dropped out at 16. So we might say chess hurt his academics.

The question I would like answered is does chess help young children at risk. The kids who are having reading or math problems, does chess help them? Why does it help, if it does? What is the mechanism? But of course those questions are not answered, making the studies above , even ignoring their methodological issues, less than worthless.

Having taught very young kids chess, it is quite true that you have to teach them basic arithmetic when you teach them chess. That was a surprise to me, but without doing so, they cannot be taught how to evaluate a position. To answer the question "should I trade my Queen for a Bishop and a pawn" requires them to be able to add, subtract,and compare the size of numbers. That's advanced math for really young kids. If you teach kids king and pawn endings, and use the "rule of the square", then you have to teach them how to construct a square (the square of the pawn) from a diagonal. More math. And as we are talking about young kids, if you want them to record their moves, you have to teach them to write. THAT is tough for really young kids, especially boys, who seem to be slower than girls to develop the hand coordination that writing ones moves legibly in the small lines of a chess score sheet requires.

Shurlock_V 3/31/2016 06:07
You know what else makes kids in school smarter?

Teaching them.
Anything.

There are a host of other skills that a significantly more valuable than chess that kids should be learning. The push for chess in schools is a push to make money that comes from suckling institutional teats.

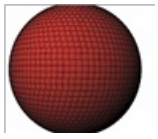
amosburn 3/31/2016 04:45
Clearly, just teaching someone the moves has no measurable benefit. Becoming proficient at chess can change how you think, but that must take time. If the benefit goes from 0.34 to 0.43 after 25 hours, that sounds very significant. If you are going to do it, do it well

Raymond Labelle 3/31/2016 03:37
"A concrete possibility is thus that chess instruction requires a certain minimum amount of time (about 25-30 hours) to show appreciable effects (above 0.40)."

Question: we are referring to 25-30 hours in what time frame? A month? A semester? If a week, not much time left for ordinary school, so probably not.

birdgeo 3/31/2016 06:36
"lies, damned lies, and statistics" is a trite saying that is thrown around to disarm legitimate debate.
Statistics are mathematically valid when derived from, and applied to, populations. They are invalid when applied to individuals within the population. The authors here correctly use the method. So rather than throwing around trite cliches, it would be better to actually cite the data in the article that one finds objectionable and then support that objection with data and alternative conclusion. But don't take my word for it - I only have a PhD in geophysics, and a research professor ....

Isledoc 3/31/2016 04:28
I love chess but it is a pastime.Statistics can prove just about anything-'there are lies,damned lies and statistics'.Spending a lot of time studying chess will make you good at chess(as Magnus said recently and others before).You might be better off using that time to learn another language or improve your math skills.Great website thanks so much for all the interesting content.



abhayanniya 3/31/2016 02:48
good

We take the instruction modeling approach, which attempts to model the activities and decisions of some of the world's most effective teachers in its artificial intelligence—like how they remedy gaps in student knowledge, how they decide the difficulty level of problems to give students, and how they scaffold explanations. We've found, however (as you may expect), that a successful implementation also requires teachers to take an active role in student learning. Based on our experience, we've put together the following summary of some of the benefits and limitations to look out for as artifici Moats exposes popular but scientifically untenable practices in reading instruction, including # use of memorization, picture cues, and contextual guessing for teaching word recognition, justified by the faulty "three cueing systems" theoretical model, instead of direct, systematic teaching of decoding and comprehension skills; # substitution of "teacher modeling" and reading aloud for explicit, organized instruction; # rejection of systematic and explicit phonics, spelling, or grammar instruction; #

confusion of phonemic awareness with phonics; # reliance on “leveled” books and trade books to… Such has proven to be the case with teaching reading in the early grades of school.

Chess instruction in schools is on the rise, but are the benefits scientifically justified? We therefore decided that it was time to carry out a rigorous, quantitative review of the available evidence. To do so, we used the most appropriate method: Meta-analysis (e.g. Schmidt & Hunter, 2015). Meta-analysis is a statistical procedure that allows one to merge the results of many studies regarding a particular topic â€“ in our case, the benefits of chess instruction on educational outcomes â€“ into a single quantitative measure representing the size of the overall effect of one variable (chess in... Chess instruction in schools: A quantitative review. Does chess in school make children smarter? In this review of the available evidence, Giovanni Sala and Fernand Gobet show that chess instruction in schools provides some moderate effects, especially in boosting childrenâ€™s cognitive and mathematical skills. Ultimately, it is shown that while providiâ€¦ Chess instruction in school has been proposed as an intervention to address this objective. The conventional wisdom that chess instruction may enhance pupilsâ€™ academic performance has stimulated numerous research projects worldwide over the last two decades. Most of the studies have focused on the putative benefits of chess instruction on achievement in mathematics.Â The Roadmap proposes a concrete overview of the implementation of open schooling approaches, offering a clear description of the necessary steps that schools will need to take in order to become hubs of responsible innovation that bring together as many stakeholders as possible with an aim to produce ideas and solutions that address local issues and challenges.