Effect size

An effect size quantifies the strength of an experimental effect (in our case, the effect of chess instruction. We used the standardized means difference (Cohen's *d*), which was calculated with the following formula:

$$d = (M_e - M_c) / SD_{pooled} \quad (1)$$

where SD_{pooled} is the pooled standard deviation and M_e and M_c are the means of the experimental group and the control group, respectively.

Results

The results show (a) a moderate overall effect size (d = 0.338, 95% Confidence Interval (CI) [0.242; 0.435], $p < .001$); (b) a greater effect on mathematical (d = 0.382, 95% CI [0.229; 0.535]) than cognitive (d = 0.330, 95% CI [0.130; 0.529], $p = .001$) and reading abilities (d = 0.248, 95% CI [0.128; 0.368], $p < .001$); and (c) a positive effect of duration of treatment ($Q(1) = 3.89$, $b = 0.0038$, $p < .05$, $K = 35$).

Put simply, chess seems to improve significantly both academic and cognitive abilities, and this applies especially to mathematics. Interestingly, the positive effect of chess instruction is directly related to the duration of treatment (i.e., duration of chess courses).

Conclusions

These results suggest that chess practice improves children's mathematical, cognitive, and to a lesser extent, reading skills. Most importantly, the positive influence of the hours of treatment on the results seems to support the idea that chess skills do transfer to other domains. Trinchero (2012) has suggested that appreciable positive effects occur only after 25 – 30 hours of chess instruction. In his seminal synthesis of more than 800 meta-analyses from educational interventions, John Hattie (Visible Learning, 2009) has established an average effect size of 0.40. According to Hattie, any educational activity exerting an effect of more than 0.40 on academic outcomes can be considered desirable. We found that for studies with a minimum of 25 hours of instruction, the overall effect size was d = 0.427, which is a value – according to Hattie's analysis – in the so-called "zone of desired effects" ($d > 0.4$). This suggests that chess training may be more effective in enhancing children's cognitive and academic skills than many (at least more than 50%) other possible educational interventions, but only if the intervention lasts at least 25 hours.

Although this outcome seems encouraging, two considerations should be borne in mind. First, the overall effect size is not large enough to convincingly establish the effectiveness of chess practice in enhancing the skills in consideration. Second, the observed difference between treatment and control groups might be due to chess instructors' passion rather than chess itself, because the potential role of placebo effects was rarely, if ever, controlled. In fact, no study used an "ideal design" (Gobet & Campitelli, 2006), including pre- and post-test, full random allocation of participants to conditions and, most importantly, both a do-nothing control group and an active control group. For this reason, in spite of the promising results, whether chess instruction is or not effective in enhancing children's academic and cognitive ability is still an open question. Future studies should address the latter issue by adopting a more suitable design (i.e., the one described above), in order to rule out potential effects of other confounding variables – such as the state of motivation induced in pupils, or the passion of chess instructors.

Giovanni Sala and Fernand Gobet[1]

Chess Effectiveness in Enhancing Students' Academic and Cognitive Skills: A Meta-Analysis

Abstract

In recent years, pupils' poor achievement in mathematics has been a concern in many Western countries. Chess instruction has been proposed as one way to remedy this state of affairs, as well as improving reading and general cognitive abilities. The aim of this study is to quantitatively evaluate the available empirical evidence that skills acquired during chess instruction in schools positively transfer to mathematics, reading and general cognitive skills. The selection criteria were satisfied by 24 studies (40 effect sizes), with 2,788 young people in the chess condition and 2,433 in the control groups. The results show (a) a moderate overall effect size (d = 0.338); (b) a stronger effect on mathematical (d = 0.382) than reading ability (d = 0.248), and (c) a significant and positive effect of duration of treatment ($Q(1) = 3.89$, $b = 0.0038$, $p < .05$, $K = 35$). Moreover, for studies with a considerable amount of hours of training (25 or more), the overall effect size is d = 0.427, a value considered desirable for academic outcomes. The results are therefore promising, although nearly all studies have used sub-optimal experimental designs. Suggestions for future studies are discussed.

Method

The aim of this meta-analysis[2] is to quantitatively evaluate the available empirical evidence that skills acquired during chess instruction in schools positively transfer to mathematics, reading and general cognitive skills. A systematic search strategy was used. The studies were included according to seven criteria:

1. The design of the study was experimental or quasi-experimental; correlational and ex post facto studies were excluded.
2. The independent variable (chess training) was successfully isolated; the studies using chess training as only one of several independent variables in the experimental group were excluded.
3. The study compared between a chess intervention group and at least one control group.
4. The treatment and the control groups did not differ in terms of grade (e.g., third graders compared to fourth or fifth graders).
5. During the study, a measure of mathematical, reading, or cognitive skill was collected.
6. The participants of the study were pupils from kindergarten to the 12th grade.
7. The data presented in the published study were sufficient to calculate an effect size or the author(s) of the study, after having been contacted, provided the necessary data.

We found 24 studies – conducted from July 1976 to July 2015 – that met all the inclusion criteria (see Table 1). These studies included 25 independent samples and 40 effect sizes, and a total of 5,221 participants (2,788 in the experimental groups and 2,433 in the control groups).

1 Department of Psychological Sciences, University of Liverpool, Liverpool. E-mail: Giovanni.Sala@liv.ac.uk; Fernand.Gobet@liv.ac.uk.

2 A meta-analysis is a statistical method for combining the results of different experiments.