The Effect of Chess on Reading Scores:
District Nine Chess Program
Second Year Report

by

Stuart Margulies Ph. D.

The American Chess Foundation
353 West 46th Street
New York, NY 10036

(212) 757-0613

The Effect of Chess on Reading Scores:
District Nine Chess Program, Second Year Report

Summary

Students in a New York City chess program improved reading scores more than a control group. The gains made by chessplayers were compared to national performance and district performance.

Chessplayers outperformed the average student in the country and the average student in the district.

The gains made by chessplayers were statistically significant at the .01 level. Thus the chances are only one in a hundred that these gains were due to chance.

District Nine in the Bronx, New York City, conducted the chess program.

This study evaluated two years of this program. Teachers and chess masters provided instruction in the first year. Instruction was enhanced in the second year by the addition of computers and software supplied by IBM.

Chess students in the computer-enhanced program were significantly more likely to show gains than a control group who had the same average reading scores at the beginning of the year but did not receive chess instruction.

Several theories are offered to account for the gains made by chessplayers, but no conclusion is reached.

Acknowledgments

Many people contributed to the District Nine Chess Program and helped prepare this report. Cliff Jackson managed the program and facilitated this research. Without his hard work, none of this would have been possible.

The District Nine teachers served as chess coaches and did the day to day work which made this program run. These teachers included Ms Teresa Easton, Mr Onwuzinger, Mr T. Nievas, Mr Mark Singer, Mr Frank Hennessy, Mr Victor Vargas, Mrs Florence Marin, Mr Darnell Gatling and Mr W. Lissimore. Many other teachers also did this core job of organizing and teaching.

Chess masters provided both instruction and inspiration. They also helped assemble the data needed for this report. I would like to thank Bruce Albertson, Doug Bellizzi, Maurice Ashley and John Kennedy for their help.

Mark Levine was both a chess coach, a tournament director, and the computer expert on this project. Shelby Lyman helped bring this project to reality. He encouraged the research effort, and provided encouragement and inspiration to all participants.

Many people in the District Nine office provided essential help in assembling the data and analyzing it. Gordon Gilbertwas extremely helpful in all phases of this study. We could not have prepared this report without his help. Dr Edward Whitney helped us get organized and prepared the analytic study on which we relied. Dr Lewis and Dr Gargan commented on the report and Dennis Kagan and Arnie Insler helped us assemble the data.

Professor Les Ault helped to design the study and reviewed the report many times. Dr Jan Eglan analyzed the report and helped prepare the statistical analysis. Dr Eliot Hearst made many substantial contributions. Each of these three consultants are also experts in chess research and helped prepare the final section of the report. Steven Fried and Dr Allan Edwards are prominent researchers who helped review this study. I could only implement a fraction of the many suggestions these and other reviewers made.

Dr Bat-Chava was our statistical expert. Dr Hodges helped to design and edit the report, and made many suggestions for revision. Mark Yoffie and Alex Belth helped with the slow and tedious work of assembling and checking the data.

Allan Kaufman of the American Chess Foundation provided support and encouragement at all stages of the project. We turned to him to solve any difficulties and he responded with competence and speed. IBM provided funding for many aspects of the chess program and for this research study. The IBM representatives, Zeke Seligsohn and Jim Courage, have a firm commitment to assisting the students of District Nine and to this research effort. They provided consistent support throughout this research. Also, they provided a model of hard work and dedication.

Many people in District Nine labored to get this project going in years past. We offer them our thanks.

Overview

Elementary school students in New York City's District 9 received instruction in playing chess. Students in the program improved reading scores more than control groups. Gains were statistically significant at the .01 level.

Background

District Nine, located in the Bronx, New York City, has a comprehensive chess program. In the first year of this study, students in the mid elementary school grades joined chess clubs in school. Instruction and inspiration were given by teachers who also served as coaches, and by chess masters provided by the American Chess Foundation.

In the second year of this study, this program was greatly enhanced by an IBM-supported initiative. IBM provided computers, software and support for chess activities. As a consequence, students could practice against computer chess software and were able to play matches against distant opponents through a modem-mediated network. This second yearof the study was termed the computer-enhanced program.

Participation in the first and second year chess programs was voluntary.

Selection of Subjects

This report evaluates reading performance of students who participated in chess programs. Subjects in the first year were students who participated in the 1990 District Nine Chess Tournament. Second year subjects were chess team members in the computer-enhanced program. All students who played in the 1990 tournament and all team members in the 1991 computer-enhanced chess program were included if they met the following criteria:

1. They must have taken a Degree of Reading Power Test (DRP) at the end of the school year and in the prior year. The DRP test is given once a year, in May. Students who transferred into District Nine from other states and students who were absent when the test was given were excluded from the study.

2. Students must have scored at the 10th percentile or higher on the DRP test at the beginning of the school year. Students who scored between 0 and 9 percent or students classified as Limited English Proficiency were not included in the study. This constraint was imposed because the DRP test may be less reliable under the 10th percentile. There was no upper limit to DRP scores.

The effect of instituting a cut-off at the lower end of scores and no cut-off at the upper end was to make it more difficult to demonstrate reading gains among chess participants.* Inclusion of these students would probably have resulted in higher gains for chessplayers, but would have been subject to the criticism that the scores were unreliable. Adoption of the criteria we chose was a conservative decision.

Since we obtained significant differences with this procedure, we increase our confidence in the result.

Results and Data Analysis

Table 4 in Appendix 1 shows the reading scores of chessplayers before and after joining the chess program. A 50% score means the student is average in the country for that grade on the DRP test. A score of 99% means the student is one of the best readers in that grade for the reading skills tapped by the DRP. A student who scores in the 50th percentile in May 1991 and who continues to perform in an average fashion, will score in the 50th percentile one year later, in May 1992. An increased score indicates an above average performance. The use of percentile scores is discussed further in the section on control groups.

** For example, one of our students scored at the 99+ percentile and several obtained very high scores. Such students may be able to get almost every question right on the pre-test and post-test even before they enter the chess program. Even if they made enormous gains in reading as a result of playing chess, we would see no gain. And should these students have been ill when they took the post-test, it is hypothetically possible that they would have shown a big drop. Similarly, one of our students scored at the second percentile on the pre-test and was dropped from the study. Many other students obtained very low scores and were also dropped. Any reading gains made by these students would not have been registered. Because the students scored close to zero, it was not possible to show a loss.*

Inspection of the 53 scores shows that many of thechessplayers demonstrated gains. Percentile scores are inappropriate for statistical analysis. In order to have an appropriate metric, the percentile scores are converted to standard scores. All scores were converted to NCE scores, a normalized equivalent score.

Table 5 in Appendix 1 shows the converted scores. Chess participants showed a gain in percentile score of 5.37. Non-participants showed no gain. Table 1 shows that this result is significant beyond the .01 level.

Students in the first year (November, 1990 to May, 1991) chess program and team members in the computer-enhanced program (November, 1991 to May, 1992) were combined in performing the analysis shown in Table 1.

We also sought to determine whether the computer-enhanced program might itself demonstrate significant gains in reading. The computer-enhanced program was evaluated by the Chi Square test. Scores on the DRP reading test were compared prior to and after participation in this program. The scores of 22 chess team members were analyzed.* Fifteen went up and seven went down. Control groups were formed to evaluate the significance of this result. If a Castle student was in School 114, 4th grade, then the remainder of that school's 4th grade class was put into the control group. There was a total of 1,118 non-participating students in the classes from which the chessplayers were drawn. Of these, 491 scored higher and 627 scored lower. The Chi Square test of statistical significance was applied. The results, which are statistically significant at the .05 level, are shown in Table 2.**

This result is quite impressive. Stated simply, it tells us that while most District Nine students under-performed the national average in the second year of this study, most chessplayers*** outperformed the national average. This provides another confirmation of the power of the computer-enhanced chess program to improve reading scores. The use of an additional control group, as discussed in the next section, increases our confidence that chess participation increases reading scores.

Control Groups

The tests used in this report were based on percentile scores on the DRP reading test. Comparisons were made between chess participants and control groups made up of non-participants. The details of this comparison are discussed in this section.

** There were 24 students, 2 of whom had the same score. Equal scores were dropped in this Chi Square test.*

*** Note that the Chi Square test tells us that the number of chessplayers who showed gains (15 out of 22) is significant when compared to the number of non-chessplayers showing gains (less than half). This test is insensitive to the size of gains made by the chessplayers. It treats a gain of one point in the same manner as a gain of 50 points. The t-test, on the other hand, is sensitive to the size of the gain. It tells us that the amount of gain is significant.*

**** We have used the term chessplayer to mean a participant in the District Nine chess program and the term non-chessplayer as equivalent to non-participant. We have used this terminology even though there may be some students among the 1,118 non-participant control group who know how to play chess but did not participate in the program.*

Table 1. Paired t-test evaluating significance of reading gains

Variable	Number of Cases	Mean
Pre-test Scores	53	57.69
Post-test scores	53	63.07
Difference	**Standard Error**	**t-value**
5.37	1.79	3.01
	Significant beyond the .01 level	

Table 2. Comparison of results of chessplayers in the computer-enhanced Program and all non-chessplayers

	GAIN	LOSS	TOTAL
ALL NON-PARTICIPANTS	491	627	1118
CHESS PARTICIPANTS	15	7	22
Chi Square = 5.16	**Significant at the .05 level**		

Table 3. Comparison of results of chessplayers in the computer-enhanced Program and high-scoring non-chessplayers

	GAIN	LOSS	TOTAL
HIGH NON-PARTICIPANTS	245	410	655
CHESS PARTICIPANTS	15	7	22
Chi Square = 8.52	**Significant at the .01 level**		

An average student in 4th grade scores at the 50th percentile on a reading test. If this student continues to grow in proficiency at an average rate throughout the year, he or she will be an average reader in 5th grade and once again score at the 50th percentile. This student will be a much better reader in 5th grade than in 4th grade, even though he or she will still score at the 50th percentile. Similar considerations apply to a student at a higher or lower percentile. A student who started the school year at the 80th percentile and ended the year at the 80th percentile would have gained a lot of reading competence, but would show no gain in percentile score. A student who begins the school year at the 80th percentile is no more likely to show a gain than the student who begins the year at the 50th or 30th percentile.

District Nine chessplayers show an average gain of 5.4 in percentile score. Nationally, students who take this test at yearly intervals do not show a gain in percentile ranking. This comparison shows that chessplayers in District Nine significantly outperform the average student in the country. Our next comparison shows that chess participants outperform other students in District Nine.

We examined the reading scores of all students in District Nine during the two years of this study. This was done to ensure that the 5.4 percentile gain among chessplayers did not come in part or in whole from gains in the district. (A district may show a gain or a loss from year to year in the average percentile scores achieved by students. For example, if a district spent three periods a day on reading instead of one, if class size were reduced, if funding were increased, or if there was an abundance of school counselors and a hot lunch program, the average student in the district might gain a few percentiles. Similarly if these factors were to change in the reverse direction, a district might show a decline in readingscores.) The information that there was no gain in reading percentile scores in the district during these two years is provided in the study *District Nine Achievement Patterns*, by Edward Whitney, Ph.D. published in July, 1992. On the basis of this study, we can conclude that chessplayers significantly outperformed other students in District Nine.

We must also consider another possible control group. Although some chessplayers have very low entry reading levels, the average chessplayer has a higher than average entry-level reading score. We must rule out the possibility that above-average District Nine students, whether or not they play chess, make substantial reading gains even if the rest of the district does not. Thus we formed a control group of non-chessplaying students with high entry-level reading scores in order to evaluate the Chi Square test result shown in Table 2. The next paragraph describes this control group.

We have shown previously that 15 of the 22 participants in the computer-enhanced program (68%) made gains while only 491 of 1,118 non-participating students (44%) showed gains. We need to examine gains made by the non-participants who had high initial reading scores. Of the 1,118 students in the same classes as the chessplayers, 655 had initial reading scores at or above the 30th percentile. 245 of these 655 (37%) showed gains; 410 showed losses. Thus 68% of chessplayers showed gains while 37% of the control group showed gains. (Again it should be noted that this control group consisted of classmates who had comparable average reading scores at the beginning of the year.) Table 3 presents a Chi Square analysis of this data. Analysis of Table 3 makes it clear that the gains made by the chessplayers are not due to the fact that their entry scores are

above average for the district. This table also highlights the power of the computer-enhanced program. Chessplayers in this program were much more likely than non-chessplaying classmates to improve their percentile reading scores, although both groups had comparable reading scores at the beginning of the year.

A further analysis makes the same point. Table 6 in the Appendix shows all 53 chessplayer pre-test and post-test scores arranged in ascending numerical order with the associated gains and losses. It shows that gains are not coming from students at the 80th and 90th percentile, but from average students. This table must be interpreted with great caution because of statistical concerns*, but it does provide additional evidence that reading gains are not attributable to the fact that many of the chessplayers are above average students. We can cautiously conclude that reading gains would have been just as high or possibly even higher if District Nine chess participants were drawn from students who had somewhat lower reading scores at the beginning of the program.

This report provides data from two years of the District Nine chess program. A third year of analysis will provide additional data. Although considerable caution is necessary because of the limited sample size, the results suggest that chessplayers make gains in reading.

Discussion

Why does chess help reading?

The results of this study suggest that chess participation enhances reading performance. An understanding of this phenomenon was sought through interviews with chess masters and teacher-coaches, and by an examination of the literature on the transfer of training.

Chess masters believe that chess play develops general intelligence, self-control, analytic skill, and increased ability to concentrate. They argue that enhanced reading skills naturally follow. This point of view is not accepted by most educators who question the concept of general intelligence.

The teachers in District Nine believe their chessplaying students develop enhanced ego strength as they increase their chess competence. They argue that students who feel confident and good about themselves naturally learn to read better.

A third explanation for these enhanced reading scores is that chess participants form a pool of intellectually gifted and talented students. Students who join this group make contact with a core of high achievers and thereby develop more academic interests, speak at higher levels of standard American speech and take on the values of achievement. Our research does indicate that although some chessplayers began the year as poor readers, the chess program attracts a higher percentage of excellent readers than are found in the general District Nine population. This supports the possibility that chess participation does function as an Intellectually Gifted and Talented Program.

** These include effects called "regression to the mean" and "ceiling effects". The same caution is necessary in interpreting Table 3.*

There is a fourth explanation for our findings which is quite speculative since it involves a complex comparison of chess and reading. If it can be shown that skills and cognition necessary to play chess well are very similar to those required to read well, educators would have no difficulty assimilating the results obtained in this study into general education theory. Educators doubt that any activity can generate general intelligence. The old theory that learning a difficult subject like Latin develops mental discipline is not accepted by most educators, although research in this area continues and the results are not all in. Still, educators would readily accept the notion that chess-playing enhances reading performance if substantial overlap can be demonstrated between the skills and cognition required in both activities. Unfortunately, a convincing analysis of the skills and cognition required for reading and chess-playing at the age levels considered in this study does not exist.

Let us consider here the skills and cognitions involved inreading and in chess and try to determine the extent to which they are related.

Reading-with-understanding and playing-chess-well are complex, little understood operations. Reading may be analyzed into lower level and higher level processes. For example, a child may read a story about a cockroach seen in a restaurant. Low level processes involve decoding words such as “restaurant”, “waitress” and “astonished” while also understanding grammar and usage. Higher level processes require an information component (eg. information about restaurants, about what people do there, the implications of finding a cockroach, etc) and a thinking component (i.e. processing, comprehending, analyzing, in short all the higher order skills required to construct meaning from the story).

The student glances at a word or phrase, employing lower level skills for decoding and then tries to integrate this new information into a pre-existing context to obtain meaning. The process is constantly extended as each new word is “read”.

This description of the reading process is similar to many descriptions of the chess-playing process. Chessplayers combine high level processes - knowledge and information about the position - and an interactive approach in which each “candidate move” is considered much like a word or phrase in reading. The cognition processes are very similar. Both chess and reading are decision-making activities and some transfer of training from one to the other may be expected.

Several explanations have been offered for the findings obtained in this study. Perhaps all of these explanations apply, some to one student, some to another. This might explain why a large percentage of chess-playing students make gains in the District Nine chess program.

Conclusion

Chess participation appears to enhance reading performance. Further research is needed to confirm this result and to help us understand the power of playing chess.

Appendix 1

Chess Participants' Reading Scores: Combined Scores of Both Years

Table 4. Chessplayers' Percentile Scores on Pre- and Post-Tests

STUDENT ID	PRE-TEST SCORE	POST-TEST SCORE	STUDENT ID	PRE-TEST SCORE	POST-TEST SCORE
1	15	61	28	79	75
2	61	66	29	77	81
3	61	75	30	95	99
4	28	77	31	65	81
5	91	87	32	86	92
6	69	97	33	65	58
7	24	90	34	37	38
8	23	46	35	37	34
9	83	78	36	94	91
10	69	97	37	99	99
11	54	92	38	97	97
12	44	15	39	89	96
13	42	46	40	76	89
14	18	42	41	21	29
15	98	97	42	21	23
16	87	63	43	75	53
17	67	88	44	67	88
18	33	16	45	24	28
19	84	96	46	16	18
20	75	68	47	58	89
21	50	47	48	49	55
22	91	84	49	68	44
23	65	64	50	86	67
24	52	54	51	49	54
25	71	84	52	92	86
26	61	85	53	10	20
27	73	88			

Number of Cases: 53