Correlates of the Effectiveness of Chess Training as Cognitive Training for Children with Attentional Problems

Daniel G. Saldana[1,2], M.A., Al Amira Safa Shehab[1,2], M.Sc., Joel R. Sneed[2,3], Ph.D.
[1]The Graduate Center, City University of New York, [2]Queens College, City University of New York, [3]Columbia University and the New York State Psychiatric Institute
Email: daniel.saldana@qc.cuny.edu

BACKGROUND

- Chess is a multifaceted game that employs several cognitive functions.[1,2] Our pilot study implemented a chess training program to improve cognition and behavior in children with parent reported attention problems.[3]
- After 12 weeks of training, the following outcomes significantly improved:
  - Cognitive: sustained attention, processing speed, and working memory
  - Behavioral: inattention and hyperactivity
  - Chess tactical ability
- The current follow-up analysis aims to determine whether cognitive and behavioral improvements were driven by improvements in chess tactical ability.

METHODS

- Twenty-four children, ages 5 to 12, participated in a 12-week chess program which included instruction and daily tactical puzzle-solving on a computer/tablet.
- **Neuropsychological battery:** National Institute of Health (NIH) Toolbox subtests: Flanker Inhibitory Control and Attention Test, Dimensional Change Card Sort Test, Picture Sequence Memory Test, List Sorting Working Memory, Pattern Comparison Processing Speed Test.
- **Behavioral measures**: Strengths and Difficulties Questionnaire (SDQ), Parenting Stress Scale, ADHD Rating Scale IV, Kiddie-Schedule for Affective Disorders and Schizophrenia, Clinical Global Impression Scale.
- **Statistical Analysis**: Pearson's bivariate correlations were conducted to assess the relationship between change scores of cognitive and behavioral outcomes and change in tactical ability. Linear regression and mixed effects models were conducted to determine the contribution of improvement in tactical ability in predicting cognitive and behavioral improvements over time.

RESULTS

- Improvement in chess tactical ability was not correlated to changes in any of the cognitive and behavioral variables of interest (all *ps* > 0.05).
- One-tailed Pearson correlations driven by our hypothesis that change in cognition and tactical ability will be positively correlated demonstrated that **change in tactical ability was significantly correlated with change in processing speed (r = .38, *p* = .04)**.
- The **improvement in chess tactical ability did not significantly predict change in any of the behavioral variables (all ps >.05)**. Linear mixed effects: While all behavioral variables significantly changed over time (p< .00), **change in chess scores did not incrementally significantly predict behavioral outcomes**.

	ß	SE	t value	p value	Adjusted R^2
Processing speed	0.01	0.02	0.27	.79	-0.05
List sorting-diff	-0.01	0.02	-0.31	.76	-0.04
Flanker-diff	0.02	0.01	1.29	.21	0.03

Table 1. Separate regression models with chess tactics difference as predictor

Predictor	ß	SE	t value	p value
Intercept	43.42	5.18	8.39	.00
Time	**7.09**	**2.45**	**2.89**	**.01**
Tactics difference	0.02	0.01	1.14	.27

Table 3. Linear Mixed Effects Model with working memory as outcome

Predictor	ß	SE	t value	p value
Intercept	44.41	7.11	6.24	.00
Time	**11.9**	**2.99**	**3.98**	**.001**
Tactics difference	-0.01	0.02	-0.27	.73

Table 2. Linear Mixed Effects Model with processing speed as outcome

Predictor	ß	SE	t value	p value
Intercept	45.13	4.3	10.5	.00
Time	**4.61**	**1.57**	**2.94**	**.01**
Tactics difference	0.001	0.01	0.12	.91

Table 4. Linear Mixed Effects Model with Inhibitory Control and Attention as outcome

DISCUSSION

- These results suggest that gains in hypothesized cognitive and behavioral measures may not be correlated to chess training.
- There was a trend suggesting that chess instruction may be related to improvements in processing speed. The improvements reported in the pilot study may demonstrate nonspecific effects of training akin to other chess training paradigms in the literature.
- The limitations of the study included small sample size and lack of a control group.
- Given the paucity of studies of chess instruction in at risk populations (e.g., ADHD, learning disorders), it is possible that a study with an improved design may further elucidate the benefits of chess training.

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