CHESS AS A WAY TO TEACH THINKING

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While much recent research on decision-making and problem solving stresses the limits of rationality and how far we humans deviate from "good" decisions, chess is a situation in which humans can make unusually sound decisions. In fact, young children—not normally known for their rationality—can compete with adults on an even basis and make good decisions that appear rational or analytic. This raises some very interesting questions for educators: How can children, before reaching the stage of formal operations, think so logically? Studying the best thinking of which children are capable and how they develop those skills may yield some valuable ideas for educators.

Chess and Education

The United States Chess Federation sells buttons that say "chess makes you smart." Among the presumed educational benefits are improved concentration and mental discipline, better skills in planning, and an appreciation of the consequences of actions. Chess educators have argued that chess is beneficial, not just for the intellectually gifted, but also for learning disabled and hyperactive children. Among parents and chess teachers, countless case studies attest to the educational benefits of chess. When we started our research on chess, however, we found very little experimental research with children. In a rare study, Christiaen (1978) studied fifth graders for two years during which an experimental group studied chess after school, one day a week. After the two years, the experimental group performed better on Piagetian tasks, significantly better on school tests, and better on standardized tests than did the control group. Chi (1978) demonstrated that child players could remember more pieces from a chess scene than adult non-players could, thus demonstrating that knowledge can be more important than age when subjects are asked to recall a complex array. Chi suggests that some of the age differences typically reported in developmental studies may be attributable to differences in knowledge about the stimuli rather than to memory factors alone.

Chess Research With Adults

DeGroot (1946) found that chess masters could look at a chess scene briefly, then reconstruct it from memory, whereas less skilled players could place far fewer pieces. When given a board with pieces presented in random places, however, masters did no better than novices. This shows that the master player does not simply have a better memory; the master has a memory for meaningful configurations. Later Simon and Chase (1973) explained this phenomenon in terms of "chunking." At higher levels of knowledge, a person sees and manipulates information in larger chunks. A literate person, for example, can remember many letters if they are arranged in meaningful words and sentences, but not nearly as many if they are in a random list.

DeGroot's findings have been crucial in shaping how we think about cognition. In Search for Excellence, for example, Peters and Waterman (1982) quote the classic chess studies to show that the manager who thoroughly understands his or her organization will be better able to process information efficiently and thereby make superior judgments.

Children Who Play Chess

Most people naively believe that any child who becomes proficient at chess must be an extremely rare prodigy (probably with grandmasters for parents). On the contrary, particular chess coaches consistently produce strong players, year after year—even though the specific children move on. In many cases, the parents know little or nothing about chess. Thus, while the individual's talent is important, the training a child receives appears to be equally important. In fact coaches often say that given a few months of training, any motivated and bright 10 year old can become a proficient player. In other words, the skills we will be discussing are not limited to a select few extremely gifted children; they are trainable skills. Our sample consisted of 24 elementary children (grades 1 through 6) and 35 junior high and high school students, mostly from one small school where over 100 students belong to the chess club. Our sample consisted of the top players from the club plus other top players in the state. Grade and skill rating were correlated (r = .48), but elementary players were among the top-ranked players. Thus, all of the children could perform a highly complex cognitive task as well as most adults, and all have competed in tournaments with adults.

How Children Play Chess

The nature of expertise. As one progresses toward expertise, he or she (1) obtains increased knowledge which becomes organized in more efficient and abstract ways, (2) uses processes that become more automatic (and intuitive) through experience, and (3) takes a more global (continued on next page)
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(rather than a detailed, analytic) perspective. In some super-

peripheral ways, children operate like experts: they tend to
use intuition rather than careful analytic processes and
often ignore many of the details. Because children’s lim-

ited information processing capacities prevent them
from being analytic, they must acquire expertise in ways
that differ from adults. Krogius (1976) offers some start-

ling data showing that grandmasters who learned chess
as a child played at their peak for more years and made
fewer blunders than grandmasters who learned chess as
adults. He compared early acquired chess knowledge to
a native language; chess was for those players a first lan-
guage. We agree. And just as first language acquisition
differs from adult second language learning, chess

competencies achieved as a child may be qualitatively
different (and superior) from those acquired as an adult.

Heuristics and the avoidance of detail. In one study
(Horgan, in preparation), we found that pre-adolescent
children typically did not look ahead more than one
move (even those with ratings above the mean for adult
tournament players). This means that although an adult
and a child may perform equally well, the child actually
performs in much less time and with much less deliber-
ate analysis. This is possible because the child uses more
heuristics and avoids details. Heuristics are ways of sim-

plifying complex inputs. Children must constantly sim-

plify because their schemas (knowledge representations)
are less well developed. Pushing these schemas to their
limits and subjecting them to evaluation may speed up
the process of developing more elaborate schemas. In
Piagetian terms, assimilation and accommodation occur
cyclically as schemas evolve. The rapid testing and
retesting of schemas may accelerate development. But
more importantly, constant revision may keep schemas
flexible and the acquisition and revision processes active.
In other words, teaching children to perform a complex
task like chess may give them problem-solving advan-
tages later—at least with chess, and possibly with other
similar situations.

Satisficing. Another reason children’s moves are faster
is because they do not generate long lists of alternative
moves—they satisﬁce. That is, they search until they find
a satisfactory move (not necessarily the best move), then
cease generating alternatives. In one study (Horgan,
Horgan, & Morgan 1986), we asked children to identify
which of several boards were most similar. Younger sub-
jects stopped their search as soon as they found a superfi-
cia1 similarity. They were capable of seeing a deeper,
more signiﬁcant similarity, but few spontaneously spent
the necessary time for the search. Satisficing can be a
very useful and efﬁcient heuristic, but it may lead to
errors.

Process feedback. For experience to aid learning, the
player must receive feedback about decisions. Children
may be less defensive about their errors and able to learn
more from experience. Foreign language teachers often
report that children are less intimidated and more willing
to risk “sounding funny.” Children, because they are in a
constant learning mode, may learn more from feedback
than adults. At any rate, chess offers unusual opportuni-
ties for process feedback. In tournaments, players write
down all their moves. They then replay their games with
coaches or other players, trying rejected alternatives and
testing what the outcome might have been. This multi-
level feedback and evaluation beneﬁts all learners and is
far superior to simply knowing whether one won or lost
the game. Because children’s schemas are naturally ﬂuid
and open to modiﬁcation, children may be able to learn
faster as a result of this high quality feedback.

Calibration. Process feedback may be especially effect-
ive for well-calibrated learners. Calibration refers to the
correlation between one’s subjective assessment of one’s
own knowledge or skill and an objective measure of
one’s knowledge or skill. In general, people are poorly
calibrated (Glenberg, Sanocki, Epstein, & Morris, in
press). With poor calibration, the utility of feedback is
limited. With accurate calibration, feedback becomes
much more beneﬁcial. Chess players are well calibrated
with regard to their skill level because of the existence of
a rating system based on win/loss records against players
at different levels. If a player’s rating is 1100, he or she
cannot truly believe he or she is at the master level! Chi-

dren quickly learn that, in general, those with higher rat-
ings will win more matches. We’ve found young players
to be brutally honest about their performance; this is no
doubt due to the fact that their ratings are public know-
ledge and have great credibility.

The rating system provides a real-life lesson in proba-

bility theory for children. Despite their ignorance of
standard deviations and probability theory, we’ve found
elementary children to be remarkably accurate in
estimating the probability of wins against rated oppo-
nents. (The U.S. Chess Federation provides mean and
standard deviation for the rating system so it is possible
to calculate the probability of a win.) We presented sev-

eral top elementary players with the type of problem
that adults (even graduate students trained in statistics)
typically get wrong:

Imagine that you will play in two tournaments. In
which of the two are you more likely to win all your
games?

1. A seven round tournament where rounds 1-3 you
play someone rated 200 points (one standard devia-
tion) below you and rounds 4-7 you play someone
100 points below you.

2. A four round tournament where rounds 1 and 2 you
play someone 100 points below you, round 3 some-
one 200 points below you, and round 4 where you
play someone 100 points above you.

The children (who are admittedly unusually bright and
among the top 10 players in the country in their age
range) correctly chose 2 and gave the reason that “with
more rounds you have more chances to mess up.” (Pro-

bability of winning all rounds in 1 is .10 and in 2 is .13.)
On this type of problem, people typically do not consider

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disconfirming evidence—they don’t estimate probabili-
ties by considering the probability of losing. In conjunc-
tive situations people tend to overestimate probabilities.
These children corrected for that bias by considering the
probabilities of their losses. Probability theory is notori-
ously counter-intuitive. If chess develops correct intu-
tions about probabilities, there could be tremendous ed-
ucational advantages.

Training

Without training or study, few chess players play well.
Just learning to move the pieces and playing with other
novices results in very slow progress. We visited schools
where enthusiastic teachers who knew little about chess
encouraged daily play. We found players with no sense
of strategy and very little skill. What they lacked was (1)
teaching of principles, (2) process feedback (they only
experienced outcome feedback whether they had won or
lost); and (3) specific chess drills. We will consider each
of these three topics.

1. Teaching of principles. Coaches do not wait for
players to discover the principles. They are taught explicit-
ly. Opening systems are memorized and practiced.
Players are urged to study chess theory. Information is
presented as a systematic body of knowledge. When
most educators think of gifted and highly motivated stu-
dents, they assume discovery learning is preferred and
memorization is undesirable. What we’ve found is that
young chess players are very adept at and enjoy
memorizing openings, learning their names, and classi-
fying them. This pleasure in acquiring a large database is
seen, particularly among boys, in collecting information
from baseball cards or information about many kinds of
dinosaurs. Children acquire a large set of “book moves,”
moves that are described in text. The result is children
who can learn more book moves in less time than adults,
but children who also do not get bogged down in detail.
Children’s games are usually strongest in the opening,
where the moves tend to be more book moves, and
where principles are rather concrete (e.g., “move both
center pawns two squares each”). Starting off well gives
these children an advantage (and no doubt teaches them
the value of studying!).

2. Process feedback. A major part of learning and im-
proving chess play comes from feedback. Going over
games in detail with an expert and replaying games with
different strategies offers the opportunity for rapid
improvement. Learning to analyze one’s own performance
objectively provides an excellent lesson in how to
maximize skill. In chess, a player has little opportunity to
rationalize losses; children learn to be objective about
their own performance. In addition, their improvement
is readily measured by increased ratings.

3. Specific chess drills. Chess coaches use a number of
interesting training techniques. One is the use of chess
problems. Much like case studies constructed for busi-
ness students, these are problems designed to illustrate a
specific principle. Irrelevant details are omitted. Like
other kinds of puzzles, they are highly motivating since
the learner knows there is a solution.

Paradoxically, players are trained to both play faster
and to play slower. Children tend to play fast without
much evaluation of alternatives, so coaches have them
take more time with moves. In our studies, we found that
longer analysis time was correlated with a deeper level of
analysis. But coaches also stress speed training. In gen-
eral, children approach the world in a whirlwind fash-
ion, acquiring schemata rapidly (often inaccurately). If
they spent too much time analyzing all the new informa-
tion available to them, they would not learn as rapidly as
they do. Playing chess rapidly forces a global perspec-
tive and hence helps develop intuitions. Since children often
ignore details anyway, they easily learn to take in the
“big picture.” Playing fast keeps alive the rapid acquisi-
tion of schemata.

Another common training technique is to practice
playing blindfolded. This forces the player to rely on vi-
ualization. Children tend to have good visualization
skills, so that early and continued visualization practice
maintains those skills. When evaluating alternatives sev-
eral moves ahead, the physical board and pieces can get
in the way. The player with good visualization skills can
“see” the board as it might look under different lines of
play. This practice results in more flexible thinking.
The training has to be geared to the child’s level. We
observed coaches putting positions and moves into con-
text for students at different skill levels. We felt that this
foregrounding might be one key to the success of the
training. To test this hypothesis, we replicated the
DeGroot study with children (Horgan, Horgan, &
Morgan, 1986), but with one task modification. On half
the trials, before seeing the board, the child was given a
brief general comment mentioning the strategic/tactical
considerations, but not mentioning any specific chess
piece. We reasoned that if what experts “have” is a global
representation around which to organize the board, then
children ought to improve their performance if they, too,
had some organizing principle. That is, some help with
organizing the information could compensate for the
children’s lower memory abilities and level of
knowledge.

When boards were presented without the context, per-
formance was correlated with age, r = .377 and with rat-
ing, r = .301. When boards were presented with con-
texts, age and rating were less important. The context
“levelled” the performance, resulting in lower correla-
tions, r = .167 for age and r = .230 for rating. This means
that with the context, there were fewer age differences
and skill level differences. What’s more, context helped
the primary and junior high children the most. High
schoolers actually did worse with the context. The pri-
mary grade children are in a transition from pre-
operations to concrete operations and the junior high
students are in a transition from concrete operations to
formal operations. The overall pattern suggests that pro-
viding a global organizing principle may or may not be
helpful, depending on the cognitive stage of the child.

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During transition periods or early in a new stage, children may be most open to different ways of organizing information. During stable periods, they may prefer their own organizing principles.

Implications

While adults progress to expertise from a focus on details to a more global focus, children seem to begin with a more global, intuitive emphasis. This may be a more efficient route to expertise as evidenced by the ability of preformal operational children to learn chess well enough to compete successfully with adults. Educators, rather than trying to “stamp out” the intuitive, quick judgments, would do well to encourage these judgments as well as encouraging careful, analytic thought. Many pet phrases of teachers discourage quick judgments: “look before you leap,” “neatness counts,” “go slow.” It may be that practice in making fast judgments forces the integration of a child’s rapidly expanding knowledge base. The combination of forcing quick judgments and encouraging analytic processes may speed the acquisition and revision of schemas. Complex problems should be approached from both the intuitive and the reflective modes.

One clear lesson from our observations and research is the importance of taking advantage of the cognitive level of the learner. If, for example, the learner is in the data acquisition mode (as evidenced by vast store houses of knowledge about one area, such as baseball), then now is the time for memorization of facts. The training technique of playing blindfolded takes advantage of the child’s natural visualization skills and practice preserves those skills. The memory results show that appropriate foregrounding, introduced at the right time, can greatly enhance performance. The same information at the wrong time, however, can reduce performance.

Helping learners think logically is not easy. But our observations and research show that young children can be taught to think clearly and with discipline, to plan ahead, and to make sound decisions. Learning these skills early in life can only benefit later intellectual development. We’ve seen that the way children acquire these skills differs in fundamental ways from adults. Implications for education are basically twofold: teach children, emphasizing their natural capabilities, to take a global perspective and to acquire and organize data quickly, and attend to the processes of their thought rather than the outcomes.

References


NOTES

The Critical and Creative Thinking Program at the University of Massachusetts, Boston, is sponsoring its second national summer program in Boston during July, 1987. The Program is aimed at teachers, school administrators, and others interested in teaching thinking. The main focus of the program is on translating an understanding of critical and creative thinking and of techniques for teaching thinking into practical applications in the classroom, the curriculum, and the school/school system. There will be week-long, one-credit courses on topics of importance about thinking and teaching thinking; three-week, three-credit seminars and curriculum development courses; and a special administrative planning seminar. Other events in this period include three one-day practitioner’s conferences with lesson demonstrations and discussion, discussion groups, and videotape demonstrations.

The staff includes Arthur Costa, California State University (Sacramento); Stephen Norris, Memorial University of Newfoundland; David Perkins, Harvard University; Robert Swartz, University of Massachusetts at Boston; Mary Anne Wolff, North Reading (MA) Public Schools.

For further information, schedule and registration form, write: Vicki Morse, University of Massachusetts at Boston, Division of Continuing Education, Harbor Campus, Boston, MA 02125-3393, tel. (617) 929-7900.

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