

Completing the Picture:  
The Effects of Video Game Practice  
on Verbal and Performance I.Q. Scores  
in High Functioning Children

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## Abstract

The strength and nature of the video game practice effect on tests of visual and perceptual skills were examined using high functioning Grades Four and Five students who had been tested with the WISC-R for the purpose of gifted identification and placement. The control group, who did not own and play video games on a sustained basis, and the experimental group, who did own a video game system and had some mastery of video games, including the Nintendo game, "Tetris", were each composed of 18 junior grade students and were chosen from pre-existing conditions. The experimental group corresponded to the control group in terms of age, sex, and community.

Data on the Verbal and Performance I.Q. Scores were collected for both groups and the author was interested in the difference between the Verbal and Performance Scores within each group, anticipating a  $P > V$  outcome for the experimental group.

The results showed a significant  $P > V$  difference in the experimental, video game playing group, as expected, but no significant difference between the Performance Scores of the control and experimental groups. The results, thus, indicated lower Verbal I.Q. Scores in the experimental group

relative to the control group.

The study concluded that information about a subject's video game experience and learning style preference is important for a clear interpretation of the Verbal and Performance I.Q. Scores of the WISC-R. Although the time spent on video game play may, indeed, increase Performance Scores relative to Verbal Scores for an individual, the possibilities exist that the time borrowed and spent away from language based activities may retard verbal growth and/or that the cognitive style associated with some Performance I.Q. subtests may have a negative effect on the approach to the tasks on the Verbal I.Q. Scale.

The study also discussed the possibility that exposure to the video game experience, in pre-puberty, can provide spatial instruction which will result in improved spatial skills. Strong spatial skills have been linked to improved performance and preference in mathematics, science, and engineering and it was suggested that appropriate video game play might be a way to involve girls more in the fields of mathematics and science.

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## CHAPTER ONE: THE PROBLEM

### Introduction

This is a study of the relationship between video game practice and Verbal and Performance I.Q. scores in high functioning junior grade children.

### Background of the Problem

As an educator, I have long been interested in the impact of long-term video game play on the results of tests of spatial reasoning and perceptual organization skills. When I started working with students tested for the gifted program, the majority of children had relatively similiar I.Q. scores on the Verbal and Performance scales of the Weschler Intelligence Scale for Children - Revised (WISC-R), when there were no apparent extenuating factors.

As the personal use of video games increased among the general student population, I observed the difference between the two scales increase, with the Performance Scale being higher, in a growing number of cases, when no factors precipitated such a difference. I began to wonder whether a relationship between the increased use of video games and relative increases in Performance scores

existed.

### Statement of the Problem Situation

Psycho-educational assessment tools, such as the Stanford Binet, Weschler Scales and the Canadian-Cognitive Abilities Test, used to screen and identify candidates for elementary and secondary school gifted and enrichment programs, contain measurements of verbal skills and spatial reasoning and perceptual organization skills. Research suggests that video games tap directly into these spatial reasoning and perceptual organization skills and have some impact on their development (e.g., Gagnon, 1985). My experience has indicated that many of the students tested for the gifted program have been avid players of computerized video games.

Therefore, the relationship, if any, between video game practice and the non-verbal/spatial aptitude scores of high functioning students was an important research question. These effects were best understood by examining the difference between Performance I.Q. scores and Verbal I.Q. scores (P - V) of students assessed for gifted identification who owned and played, on sustained basis, video games relative to those who did not own video games.



### Purpose of the Study

The purpose of the study was to investigate the relationship, if any, between video game play and scores on non-verbal tests of spatial reasoning and perceptual organization for high functioning junior grade children.

### Rationale

The lack of awareness, among practising educators, about the effects of video game play and the potential of video games as educational tools make the questions concerning the effects of video game play important. Most children in North America have been exposed to video games and the majority own their own video systems. I believe that educators have the responsibility to understand where their students' interests and abilities lie and to maximize these contributions in the development of programming.

### Importance of the Study

If a child can be identified as exceptional on the basis of a non-verbal or performance score (and, in some school boards, this is the score emphasized) and this score has been enhanced and/or inflated (temporarily increased)

due to a practice effect, certain questions concerning the validity of the tests and programming directions arise.

Answers to questions about the effects of video games contain important teaching and learning implications for students who are more advanced in visual analytical abilities than verbal abilities, whether they be high functioning students or those from the population in general. Once we have understood the nature of these effects, we can consider our current educational practices.

#### Definition of Terms

Many of the specialized terms used in this study are common in the fields of psychology and educational assessment. Some tend to be interchanged with automaticity and their meanings are best understood contextually. I have attempted to offer generic definitions for those terms that appear with regularity in this study.

1. NON-VERBAL/PERFORMANCE/PERCEPTUAL ORGANIZATION SKILLS: the facility to express intelligence manipulatively in response to visual-concrete stimuli (Kaufman, 1979).
2. SPATIAL/SPATIAL REASONING SKILLS AND APTITUDE: the measure of spatial processes such as spatial visualization,

spatial orientation, spatial scanning, and perceptual speed (eye-hand-coordination) (Gagnon, 1985).

3. VERBAL/VERBAL COMPREHENSION SKILLS: the facility to express intelligence vocally/verbally in response to verbal stimuli (Kaufman, 1979).

4. VIDEO GAME: a computerized, electronic technology that allows for interaction using a screen and a form of keypad and that evaluates the players' actions and responses.

#### Scope and Delimitations of the Study

The study investigated the nature of the relationship between video game practice and the development of verbal skills, measured by Verbal I.Q. scores, and perceptual organization skills, measured by Performance I.Q. scores, in high functioning children.

Although I have generalized this relationship to a wider range of intellectual abilities, I have not directly studied students who were not already functioning at an above average level in the classroom context.

As well, I have not been able to randomly assign subjects from a wide geographical range into the control and experimental groups with neither group having had any experience in the condition I was examining.

It was somewhat difficult to locate subjects for the control condition (i.e., non video game owning/playing students) as the installation of video systems becomes complete and an attempt at further study on other student populations, within the same geographical area, could prove even more difficult.

### The Remainder of the Document

The remaining chapters investigated the strength and nature of the educational effects of video game experience through a review of related literature, the explanation of methodology and procedures, a look at the findings and their interpretations, and my conclusion.

Chapter Two, the literature review, examined a number of articles and studies dealing with the effects of the video game experience. It explored the issue of gender and video game performance, the effects on children's socialization, the educational benefits derived from the video game experience, the positive impact of interaction with video games on the development of spatial visualization skills, the potential practice effect of video games on spatial skills, and the current thinking on large differences between Performance I.Q. scores and Verbal I.Q. scores ( $P > V$ ) on the WISC-R.

The third chapter outlined the methods used in the

study. It described the selection of the subjects and the reliability and validity of the WISC-R along with its relationship to the video games played. As well, the methods of data collection and statistical analysis were discussed.

Chapter Four described the results of the research. Findings were presented in tables and the interpretation of the data was discussed and the analyses of variance examined.

The fifth chapter addressed the results of the research and their implications for practice and further research.

## CHAPTER TWO: REVIEW OF RELATED LITERATURE

### Organization of the Present Chapter

This chapter has been organized from a loose historical perspective and a tighter topic orientation, although there tends to be some overlap as many studies looked at a combination of issues. At the end of the chapter, an interpretation of Performance I.Q. scores on the WISC-R, by a leading expert, is examined.

### Historical Background

The educational research in the field of video game technology is comparatively recent and research studies date from the early 1980s. A wide variety of topics have been discussed but many are not based on empirical research and some of the studies are already dated because they refer to obsolete hardware and software and populations without any exposure to video games. Until recently, much of the interest lay in the area of video arcades and I have found little reference to the prevalence of computerized video games in today's homes.

A very early article that explored the educative benefits of video games (Ball, 1978) begins with a plea to

educators to pick up the lead in this field rather than cautiously sit on the sidelines and wait for business to decide on the uses of video technology. Ball strongly suggested that video games could teach everything from creativity to word and numerical skills and that the games could be adapted to content areas.

The research articles that followed Ball (1978) continued to appeal to educators to determine how video game technology could be applied to learning and often made somewhat outrageous claims regarding the powerful learning components of video games.

#### The Educational Advantages of Video Games

Needham (1982) looked at the impact of video games on American youth in an article, the title of which bears repeating, called, "Thirty Billion Quarters Can't Be Wrong - Or Can They?" Needham was concerned about the positive and negative effects of the new technology. Although the article has little statistical or theoretical foundation, it does point out the skills that accomplished video game players display (quick reflexes and eye-hand coordination) and states that the U.S. Army had modified the game, "Battlezone" to train the infantry in electronic warfare.

However, Needham also addressed the macho nature of video games, including their relative unpopularity with

females and the social milieu of the arcade environment, and the waste of time and money pointed to by the critics of video games. She, as well, cautioned the readers that the effects of new technologies are not always immediately obvious and that only time will tell us if the overall effects will be positive or negative.

Long and Long (1984) were also concerned with the new video mania or addiction but felt that there was a very positive relationship between the powerful principles of video games and motivation in learning. The chance for mastery (through practice), active involvement (where the player dictated the time parameters), motivation from continuous visual and auditory feedback, concentration, and problem solving were all discussed, speculatively. They also warned educators that it would be a long time before industry mixed video games with curriculum and that parents and educators needed to become concerned with these technological developments.

In her ethnographic study of the computer world, Turkle (1984) was also concerned with the effects of the computer culture on children. She cited the question of mind in relation to machines as a central preoccupation of our time and likened it to "what sex was to the Victorians - threat and obsession, taboo and fascination" (p. 313).

Turkle also hypothesized that a sense of mastery is a crucial achievement for youngsters who are not good at



anything else, that computer games can open up doors that the conventional route of mathematics often closes, and that computers may have a special role in providing an entry system into science and math that is more accessible to women.

Turkle admitted that there was a danger of losing oneself in the simulated world of a video game but that the process involved in play is both mathematical and procedural. The process gives the player an enhanced sense of autonomy, self-esteem and control, and it is a primary source for the development of these feelings which she saw as necessary for adulthood.

Griffiths (1991), in a paper comparing the concerns over video games in the U.S. to concerns over the use of fruit machines in the U.K., looked at past studies dealing with the positive consequences of video game playing. He listed other studies dealing with their educational use, how video games allow access to "state of the art" technology, and enhancement of cognitive skills. He also reported that the U.S. Army uses video games to train gunners and that U.S. Navy officials have used video arcades as recruitment centres with promises of better quality video games for Navy trainees.

A recent news article on video games (Van Rijn, 1991) offered the information that "Blockout," a three dimensional video game that is discussed later in the paper, is being

used in math classes to teach geometry and spatial relationships.

#### Social Issues in Video Game Research

The educative benefits predicted by Ball (1978) and the warnings that educators should sit up and take notice of video technology were echoed throughout the 1980s. Nevertheless, those concerned with the ill effects of video games and their antisocial consequences were represented in the literature as well.

As previously mentioned, Needham (1982) discussed both the pedagogical benefits and negative effects of video games on children. She also questioned criticism of the mind numbing isolation of the video game experience, beliefs that video games attract alienated middle class (though, not lower class) youth through instant gratification, the public alarm at the war game mentality implicit in video games, and the attempts of local governments and communities to keep games and kids apart through legislation due to concerns over related crime.

Needham foresaw the obsolescence of video arcades as home-style versions became more sophisticated and, repeatedly, warned the reader that we were not dealing with a sort of electronic hula hoop. She felt that the games were here to stay and we could only wait to see what those

effects were.

Turkle (1984) also spoke to the social controversy around video games. She felt that the continuing debate over the power of the games was charged with a hidden agenda and that the protest against video games was mixed with the negative feelings that people have about computers in general.

The claim that video games take time away from more valuable activities was investigated by Creasy and Meyers (1986). They looked at the effects of home video game systems upon the daily activities of 64 children, nine through 16 years of age, over a five-month period. All three groups of children (non-owners, new owners, existing owners) responded to questionnaires about their leisure activities, their school work, and their peer interactions at both the beginning and end of the study and children who had just received new games received an additional assessment.

Their results showed that, although children spent a great deal of time playing with a new video system at first, this change in leisure activities was only temporary. Activities such as television viewing, movie attendance, reading, and listening to the radio showed no significant difference after the initial interest in the video game waned (although video arcade attendance did drop).

None of the groups showed any drop in mathematics or

English grades and owning a new video game did not change the children's popularity or pattern of peer interaction. "In short, children's lives are not greatly altered for better or worse by owning a video game" (p. 262).

Griffiths (1991) agreed that data on the negative social consequences of amusement machine playing are lacking. He stated that the issue of aggression, although constantly raised, has not been widely researched; only the short term effects have been examined and there has been much speculation as to whether the procedures used to measure the aggression levels were valid and reliable. Much of the evidence for video game addiction has been of an anecdotal nature but a bona fide gaming dependency, for a minority of players, has been outlined.

#### Gender Issues in Video Game Research

Although much of the literature deals with the issue of sex differences (in spatial ability, video game interest, self-confidence in video game play, and the acquisition of spatial visualization skills), there appears to be general agreement that girls do not fare as well as boys in the natural development of spatial skills.

In their discussion of studies dealing with spatial visualization acquisition and computerized video games,

Lowery and Knirk (1982) offered considerable evidence that females traditionally score below males on spatial tests. This agreement on performance is paralleled by disagreement as to why. However, speculation is made that the timing of spatial instruction is crucial if the difference in male-female scores is to be redressed and that video games may be a valid source of instruction.

Hall (1990) completed a study with male and female subjects, ranging in age from 17 to 26 years, to test previous data that suggested that females express significantly less self-confidence in a competitive video game situation. She indicated that the self-confidence level of females was not lower than males (after competition in video, "Pong," against a good opponent) but that females were less likely to predict success when the performance outcome from a previous competition did not warrant it. She also concluded that age and experience were factors in judging one's ability and that this relationship between expectancy and performance would not be as strong in children, especially females.

Kubey and Larson (1990) were more concerned with the comparatively low level of interest girls show in high tech equipment in general. They discovered that nearly 80% of video game play was by boys and that this activity was over three times as frequent for fifth and sixth grade males as for their female counterparts and that, as girls matured,

video game playing dropped even further.

Kubey and Larson gathered data on 483 subjects and described findings on the use and experience of three forms of video entertainment - music videos, video games and videocassettes. All these media were associated with higher states of arousal in boys and Kubey and Larson speculated that much of the existing software available is oriented to males rather than females. As well, it was suggested that as girls approach puberty, matters relating to gender typing, courtship, and role enactment may reduce their involvement in video game play and that girls become more involved in software that is intellectually and emotionally meaningful to them, while boys are attracted by action orientation, competition, and eye-hand coordination activities. Finally, they pointed to a need for more understanding of the implications of the marketing of media materials to boys and not to girls.

Griffiths (1991) also reported significant association between gender and the frequency of video game playing. He offered the explanations that video game software is usually designed by males for males and that girls may become discouraged at playing games of spatial skill as this skill is not as well developed.

Finally, the literature also revealed a strong suggestion that spatial instruction, whether it be through video games (Lowery & Knirk, 1982) or field sports, such as

soccer and football (where players mentally picture themselves in relation to other plays on the field and predict the consequences of an action) (Crawford, 1992), will result in improved performance scores in girls and a greater female representation in the fields of mathematics, science and engineering.

In summary, there seems to be agreement that girls do not perform as well in tests of spatial ability, that girls are not as interested in playing action oriented video games as boys, that self-confidence in competitive situations comes with age, and that girls can acquire spatial skills through video game play and this seems to be more effective at an early age.

#### The Relationship Between Video Games and Spatial Skills

Research has been conducted which not only identifies the relationship between video games and spatial skills, but, points to a potential practice effect.

Lowery and Knirk (1982) discussed the positive impact of many hours of interaction with computerized video games on the acquisition and development of spatial visualization skills, considered largely to be right hemisphere activities of the brain. They defined spatial visualization skills as "the ability to imagine movements, transformations and other

changes in visual objectives" (p. 155) and stated that these skills are, indeed, trainable. Through an exhaustive examination of related studies, they discovered an apparent relationship between high spatial ability and ability in the mathematics and science areas and found research to support the hypothesis that spatial ability, improved through instruction, transfers to these subject areas.

Gagnon (1985) was concerned with underlying assumptions concerning the relationship between video games and spatial cognitive skills that had not been researched or substantiated. Her study examined this relationship with three stated purposes: a) to determine if a relationship between scores existed using standardized tests; b) to explore gender differences; and c) to examine the effects of video game practice on spatial aptitude scores.

Fifty-eight Harvard students, between 18 and 31 years of age, were used as subjects and they were randomly assigned to either the control (no video game play) group or the experimental (five hours of video game play) group. Subjects were considered by sex, age, and video game experience and were given four pre and post tests in the different spatial areas of visualization, orientation, scanning, and speed and accuracy.

The videogames chosen to provide the condition of the the independent variable (videogame practice) were "Targ" and "Battlezone" because of their individual features of two



and three dimensionality. Their game objectives and spatial skills were clearly presented and appeared to tie into the skills measured by the set of instruments chosen to measure the dependent variable (visual/spatial aptitude).

Internal validity was built into the procedure by informing the subjects, after the pre test and prior to video game play, that the entire group would have to be split into two, in order to avoid overcrowding at the video arcade. The first group played the video games for at least five hours over the following week and, after that, all subjects were debriefed as to the true nature of the study. Post tests were then administered and the control group was given a free week of video game play.

Gagnon acknowledged that the external validity, the ability to generalize the results to the total population, was in question as the subjects, Harvard students, scored significantly higher than national norms on the pre tests.

Gagnon discovered a significant positive correlation between video game scores and spatial skill test scores and found that different video games appeared to be related to different types of spatial cognitive skills (visualization, orientation, visual pursuit). However, more experienced video game players tended to score lower on the paper and pencil eye-hand coordination test than less experienced video game players.

Gagnon agreed that gender differences were consistently

found in measures of spatial skills and suggested that these may also be found in video game outcomes. In the study, females initially scored lower than males on tests of spatial visualization but were able to equalize their scores with video game practice. As well, when females were provided with video game practice, they improved significantly on tests of spatial visualization compared to those females who did not get practice.

Experienced video games players tended to score higher on both the video games and spatial tests. Gagnon questioned whether this was due to the possibility that people who choose to play video games have better developed spatial ability or that playing video games may, over time, have a cumulative effect on spatial skills. She found that the latter interpretation was supported by the finding that novice video game players, as well, improved significantly on one of the spatial tests.

Gagnon also discovered a negative correlation between the age of the subjects and scores on video games and spatial skills; as one gets older, scores on both video games and tests of spatial skills decrease. It is worthy to note that she was dealing with an adult population and she felt that separate studies were needed to examine the effects of video games play in the development of spatial skills in children.

Importantly, Gagnon's study points to a potential

practice effect. She explored the relationship between the simulated video game experience and real physical activities and she wondered if the player might be internalizing a whole set of intuitive rules of physics and geometry as well as understanding spatial relationships.

In another study, this time with 11 non-institutionalized senior citizens, Drew and Waters (1985) discovered significant improvement in the experimental, video playing group's full scale score on the Weschler Adult Intelligence Scale - Revised (WAIS-R). The improvement in the performance scale was especially significant with a performance mean of 9.27 I.Q. points compared to a verbal mean of 4.09.

Drew and Waters felt that their hypothesis concerning the relationship between video game play and improvement in perceptual motor performance was strongly supported by the results of the WAIS-R as well as reports by the subjects about improved coordination, better driving habits, and fewer minor mishaps at home.

Two related studies by Pepin and Dorval (1986) were undertaken to assess the effects of practice on an interactive video game on spatial visualization test scores. The first study used 70 undergraduate students from Laval University. Their average age was 22 years and they were randomly assigned to the experimental group and control group.

All subjects were pre tested and post tested six weeks later using the French Canadian Version of the Space Relations Test of the D.A.T. (Tests Différentiels d'Aptitude). In the interim, the experimental group was given eight sessions to play five games of the videogame "Zaxxon."

The video game, "Zaxxon," was said to be well designed and to effectively simulate tridimensionality. The Space Relations Test of the D.A.T. also requires the mental manipulation of tridimensional objects.

The researchers discovered that both men and women, in the experimental group, gained significantly from pre test to post test on the Space Relations Test of the Differential Aptitude Tests (French Canadian Version). As well, they discovered no sex-related differences, of significance, in visual spatial skills on the pre test, although the men scored somewhat higher.

The second experiment by Pepin and Dorval used 100 adolescents (average age of 13 years) and it revealed no significant results over pre and post test scores. Although the method was much the same as in the first study, some modifications were made and a re-examination of the procedures, by the authors, revealed several problems that may have contributed to the outcome.

Unlike the adults in the first study, very few adolescents had never played video games and the criteria

selection of having played less than 25 times combined with the experimental condition of playing only eight 25 minute sessions of "Zaxxon" made the attempt to enhance the spatial tests imbalanced at best. The experimental condition yielded 200 minutes of video game play whereas many of the control subjects may have been at the upper limit of 24 times and, likely, each of these video game sessions was sustained or, at least, longer than ten minutes long.

Pepin and Dorval did an excellent job of defending the convergent validity between the game they chose and the spatial test they gave and it was most unfortunate that no significant results were revealed in the second study. However, both the boys and girls in the experimental group did improve by six points compared to only two for the control group and the girls in the experimental group (who likely had much less video game experience) gained more than seven points compared to less than one point for the girls in the control group.

Pepin and Dorval recommended that future studies with video games and cognitive skills training should incorporate a more extended practice period, multiple training conditions, and data on convergent validity between the game and skills tested.

A recent Washington Post article (Toronto Star, March 28, 1992) that described the first major academic conference

on the video game (sponsored, in part, by Nintendo) revealed no additional information, especially in the area of related testing of cognitive skills.

Interpretation of the Performance I.Q. in the  
Weschler Intelligence Scale for Children - Revised

Alan Kaufman (1979), who worked closely with Weschler in the revision of the WISC and then supervised the standardization, data analysis and manual preparation of the WISC-R, has addressed the issues of verbal-performance (V-P) discrepancies and the abilities measured by the WISC-R subtests.

Five of the six subtests used in determining the Performance I.Q. score on the WISC-R identify the "perceptual organization" factor. The Performance I.Q. is considered a valid reflection of the child's perceptual organization ability.

Kaufman felt that differences in Verbal and Performance I.Q.'s may be indicative of discrepancies in fluid and crystallized ability rather than in verbal and non-verbal thinking. Fluid ability involves adaptation and flexibility in problem-solving situations when faced with unfamiliar stimuli; Block Design, one of the Performance subtests, is considered a prototype of a fluid ability test.

According to Kaufman, crystallized ability reflects

intellectual functioning in tasks calling upon previous training and education, and the Vocabulary subtest of the Verbal scale is an example of a crystallized ability test.

Kaufman also offered a variety of interpretations for differences in the Verbal and Performance I.Q.'s. Children from advantaged backgrounds may demonstrate higher Verbal I.Q.'s than Performance I.Q.'s ( $V > P$ ) and exceptional school achievement is often reflected in a high Verbal I.Q. Learning-disabled children often obtain higher Performance I.Q.'s ( $P > V$ ) on the WISC-R and  $P > V$  scores for culturally disadvantaged children may suggest true intellectual ability. Kaufman viewed significantly higher Performance I.Q. scores as indicators that the child may have an adaptive, flexible problem-solving approach that could lead to successful school achievement in learning environments that actively encourage and utilize this fluid ability. "Insightful educators should be able to channel good fluid ability and use it to develop the basic tools that may be deficient" (p. 29).

Kaufman felt that true differences in verbal and non-verbal intelligence may reflect greater dependency on one or the other cerebral hemispheres. A better developed right hemisphere, adept at handling visual spatial stimuli, may be suggested by  $P > V$ .

Furthermore, Kaufman (1979) suggested that when children perform better on the WISC-R right brain subtests,

those predominantly found on the Performance Scale, and the results of assessment offer evidence of a strength in the holistic style of the right hemisphere, the Verbal subtests should be examined carefully. "A right brain cognitive style can actually be penalizing a child on the verbal scale" (p. 161). When individuals can integrate analytical (verbal) and holistic (performance) processing, an overall high intellectual strength can result. This ability to shift and integrate learning styles can be considered a key ingredient to success in professions in the arts, science, and mathematics.

Kaufman considered the size of the difference between the Verbal and Performance I.Q.'s required for statistical significance to be 9 points ( $p < 0.15$ ) and that 12 points was a difference that was worthy of an explanation. Statistically, the ideal profile of a youngster would be to obtain Verbal, Performance, and Full Scale I.Q.s that are fairly similar and display few fluctuations in scaled scores, describing a true integrated style.

Kaufman also specified that not only crystallized ability but fluid thinking could be learned. A basic premise of intelligence tests is that they measure what the individual has learned and, whereas crystallized ability reflects direct and deliberate training, Kaufman saw fluid ability as developing through incidental learning gained directly from experiences in life.



Kaufman stated that Guilford's operation of evaluation, the ability to make judgements in terms of a known standard, is a mental process required for success on all five regularly administered Performance subtests but it is required only on one Verbal subtest, Comprehension. Risk takers have this ability to respond to stimuli when uncertain of the outcome.

Whenever children are retested on the WISC-R, a practice effect is said to occur, and after one or several months, the V - P discrepancy and Full Scale I.Q. are considered suspect by Kaufman. The gain is most striking on the Performance I.Q. and is related to the relative familiarity of the tasks involved; the experience gained in the use of concrete test materials is seen to lead to an increase in scores on the Performance subtests. It is a possible practice effect, through video game play, that has been given consideration in this study.

Kaufman also looked at the concept of field dependence and independence, which is important in the relationship between video games and performance testing. Field dependence-independence deals with the process of cognitive activity (perception and relationships) rather than the content. The extent to which a person perceives a part of a field as discrete from the surrounding field characterizes field dependence-independence. People who can locate figures embedded in complex designs and who can adjust their

own body or an object to an upright position, when placed in a disorienting environment, are said to be field independent. The strong power of the field characterizes field dependency. Picture Completion, Block Design and Object Assembly, three of the Performance subtests, load substantially on the field independence style.  $P > V$  differences are held by Kaufman to signify field independence.

Kaufman's approach to the WISC-R went beyond the mere reporting of numbers and an understanding of his analyses is crucial to identifying the relationship of the test to video game practice.

#### Summary of Literature Reviewed

The literature section has been developed so that the focus moves towards the relationship to the hypothesis.

The speculative educative benefits of video games from the early literature combined with the cry to educators to pay heed to their adaptation for classroom use clearly offer an important context for this study.

Literature examining the anti-social consequences of video game play employed little empirical research; certainly, there was nothing concrete enough to deter parents and educators from allowing video game use.

The literature that was concerned with gender

differences in spatial ability, video game interest, and self-confidence made it clear that girls would benefit from some early intervention in this area and such intervention may serve to increase the representation of females in the fields of science and math. As well, the issue of marketing video games to boys was discussed. Gifted and enrichment programs have always been somewhat concerned with the under representation of females and the literature discussed in this review has focused on one potential area that can be redressed.

The literature regarding the relationship among video game play and practice, spatial ability, spatial and performance testing and skill in mathematics and science in adult populations serves to offer possible theoretical foundations for this study. It also points to the need for a look at the effects of video game play on verbal and performance tests for children.

Kaufman's discussion of the Performance scale on the WISC-R offered much valuable information which relates the test to video game play. The concepts of fluid ability, field independence, and practice effects, of concrete manipulation, are critical to this study.

Despite an extensive search, however, I have not discovered any systematic investigations of the effects of video game play on the spatial skills or verbal and performance subtest scores of pre-puberty students.

## CHAPTER THREE: METHODOLOGY AND PROCEDURES

### Overview

This chapter deals with the hypothesis of the research study and the method devised to test that hypothesis. The approach is described, the design is specified and justified, the reliability and validity of the instrumentation are discussed as well as its convergence to the dependent variable. The methods of data collection and statistical analyses are also examined.

### Description of the Approach

The design of the research is quasi-experimental as it examines the possibility of a cause and effect relationship between conditions that have already occurred. I was concerned with assessing the videogame practice effect (which existed due to the ownership of a video game system and the subsequent time investment and interest in video game play) on the positive difference between the Performance scale and Verbal scale of the WISC-R (which had already been administered) in a sample of high functioning junior grade students.

Although there has been no manipulation of treatments or subjects, my professional work with Grades Four and Five

nominees for the gifted program, in my school board, allowed for the formation of experimental and control groups from pre-existing conditions. Therefore, the conditions of a true experimental design have been approximated but absolute random assignment was not possible.

### Hypothesis and Research Design

It was hypothesized, because there is a positive relationship between video game training and visual/spatial aptitude scores, that high functioning children who have had experience playing video games that tap into visual/spatial skills achieve higher I.Q. scores on the Performance Scale of the Weschler Intelligence Scale for Children - Revised (WISC-R) than on the corresponding Verbal Scale. In other words, it was expected that the difference between the Performance and Verbal Scales ( $P > V$ ) of the WISC-R is greater for children who play video games relative to children who do not play video games. It was also expected that the mean difference for the experimental group would approximate the accepted difference between the Verbal and Performance Scales that is considered statistically significant.

Therefore, the independent variable is the non-ownership and non-play/ownership and play of a computerized video system and the dependent variables are

the Performance and Verbal I.Q. Scores of the WISC-R, with interest in the difference between the scores.

### Selection of Subjects

The population of interest was composed of junior students in Grades Four and Five who had been nominated for the gifted program, who had been administered the WISC-R in the same school year, and who had been considered for gifted identification, generally through the application of the school for a hearing at an Identification, Placement and Review Committee.

The probability sample was drawn from a cluster sampling of 117 Grades Four and Five students, from nine to eleven years old, from 43 schools in a large school board in Metropolitan Toronto. The mean age of the cluster sample at the time of the interview part of the assessment process, was 9.80 years, with a Standard Deviation of 0.48 years. These children had been assessed for the purpose of gifted identification based on the recommendations of classroom teachers in conjunction with the parents. The assessment process consisted of the administration of the WISC-R, an interview to evaluate gifted behaviours and the appropriateness of placement in a withdrawal gifted program, and the scoring of a written product.

The control sample was constructed first and contained

18 students, 13 girls and five boys who had recently been administered the WISC-R and who had indicated to me, through the regular interview process, that they did not own or have immediate access to a video game system nor had they developed a strong familiarity with any video games, including the game "Tetris." At the time of the assessment, the control group had a mean age of 9.73 years, with a Standard Deviation of 0.49 years.

The experimental sample was constructed subsequently. It also contained 18 students, 13 girls and five boys, matched by age, grade, sex, and community. These students had also been administered the WISC-R but, during the regularly scheduled interview, they indicated that they owned or had immediate access to a home video game system, enjoyed playing, and had a strong familiarity with the video game "Tetris." The experimental group had a mean age of 9.80 years, with a Standard Deviation of 0.40 years, at the time of the assessment.

None of the subjects in the control or experimental group was considered an English as a Second Language (ESL) student. Performance scores for ESL children are often higher and this is considered a valid explanation of the  $P > V$  outcome.

The sample size, while small, was deemed to provide adequate data to answer the research question since it exceeded the accepted minimum of 15 subjects per group. I

was hoping for a much larger control sample so that the concept of gender effect could be explored with adequate numbers of boys and girls in both the control and experimental groups. However, the growing popularity of the home video system was a limiting factor and inherent weaknesses exist in any statistical discussion of the effect of gender.

### Instrumentation

The instrument that was used to assess the dependent variable, the difference between the Performance and Verbal I.Q. Scores, was the Weschler Scale (WISC-R) for individual intelligence.

The WISC-R has generally been seen as a useful tool in providing a very general measure of global intelligence. The test generates three scores for each individual tested, a Verbal I.Q., a Performance I.Q., and a Full Scale I.Q.

Weschler, the author of the WISC-R, established the reliability of the WISC-R using a split half procedure to ensure internal consistency. The reliability coefficients for the Verbal, Performance, and Full Scale I.Q. scores are 0.94, 0.90, and 0.96 respectively (Weschler, 1974).

The validity of the WISC-R as a true measure of I.Q. has been established by comparisons of the mean WISC-R Full Scale I.Q. to the Weschler Preschool and Primary Scale of



Intelligence (WPPSI), the WAIS and the Stanford-Binet Intelligence Scale. Coefficients are 0.82, 0.95, and 0.73 respectively (Weschler, 1974). The validities of the Performance or Verbal I.Q. Scores, separately, were not discussed in the test manual.

The reliability and validity of the WISC-R, however, are not the only questions about the instrumentation to be asked; what is also of importance is the classification of I.Q. equivalents, for diagnostic terms, used by the author. For a test subject to be considered within the "Very Superior" range, a Verbal, Performance, and/or Full Scale I.Q. score of 130 or above is required. As well, a difference of 15 or more between the Verbal and Performance I.Q. scores is considered so significant by the author of the test that the resulting Full Scale score becomes invalid. In many school boards, a Performance Score in the "Very Superior" range, alone, is considered a predictor of giftedness and is used for the gifted identification without a corresponding Verbal Score. In my experience, Verbal Scores in the "Very Superior" range alone, are generally not given as much weight.

As previously mentioned, Kaufman (1979) considered the size of V - P differences required for statistical significance to be nine points or greater and he suggested that a 12-point difference required an explanation.

## Procedures

My responsibility in the identification process included the interviewing of potential candidates after the WISC-R had been administered by a qualified tester from my school board. The interview takes approximately 40 minutes and explores learning styles and interests, career goals, leadership styles, leisure activities, and problem solving skills. I have been interviewing students for the gifted program for over five years and I have always asked them about their preferences for games (See Question 6, Appendix A). Soon after I became involved in the interview process, some students began to interpret the games question as referring to videogames. Before long, I began discreetly asking them about the extent of their interest in computers and video games, if they did not mention it first.

For the purposes of this study, the students were always carefully asked about their game preferences, whether or not they owned (or had immediate access to) a video system and if they were "good at" video games, specifically the Nintendo game called "Tetris."

Out of the pool of gifted candidates being processed, I chose those students who reported that they did not own and, therefore play on a sustained basis, a video game system as the control group for the study. Eighteen students, 13

girls and five boys, were placed in this control group. A corresponding experimental sample, matched by age, grade, sex, and community, was chosen from the group reporting video game ownership or access and experience in playing "Tetris," in the order in which they were listed in my data.

Although the lack of ownership of a computerized video game does not preclude that a student is expert in playing video games, I believe, using personal experience with my children and many others, that only personal ownership or immediate access (i.e., ownership by another member of the household) in this age group allows the time necessary for proficiency and mastery. Also, the students in the control group did not regularly play or consider themselves as good at video games while those in the experimental group all classified themselves as experienced players and stated, in their terms, that they had expertise in "Tetris."

Jones (1984) agreed that people play video games with greater mastery the more they play them and stated that the learning curve rises quickly at the beginning and then more slowly "as the players reach higher and higher levels of performance" (p. 138). The pace of improvement tends to become uniform, the task is then said to stabilize, and the video game skills are, on the whole, well retained and better retained than most procedural and verbal skills.

Ability in the video game "Tetris" was examined for two reasons. First, the action of the game approximates the

type of incidental learning that develops several of the skills tested by the Performance subtests of the WISC-R. Second, the game comes free with the hand held video system, Gameboy, and its prevalence has contributed to its popularity with hand held video game system players, players of dedicated video game systems such as Nintendo, and owners of PC computers.

Before collecting the data for the additional purpose of my study, I sought approval from a Supervisory Officer of the school board. He felt that informed consent from the parents and students involved was not necessary as the interviews with the students lay within my recognized area of expertise and the data obtained were from information that I was already apprised of in the course of my work. As well, the information about the research participants has been kept confidential and no names or specific locations have been mentioned in the study.

After the data were organized, letters were sent to all of the parents whose children were used as subjects, advising them of the study and informing them of the details that his/her child had provided regarding video game experience (see Appendices B and C).

Four parents called me to inquire about the study but none offered substantially different information regarding their child's interest and time investment in video game play than the self-reports of the children. In two cases,

from the control group, there was a computer/video system in the household, but one child had never expressed an interest in games and the other had had very restricted access both before and at the time of the interview and the video system had long been put away.

### Data Collection and Recording

The data were collected over the period of the 1991-1992 school year during the normal screening and identification process in which I was involved.

I was generally informed of the WISC-R results prior to the interview taking place as part of the procedure for making recommendations to the school administration regarding the I.P.R.C. application.

After I interviewed each candidate for the gifted program, I simply added the information about the child to my regular notebook and listed the name of the student, his/her sex, the verbal and performance scores on the WISC-R, whether or not s/he owned a video system, and if so, his/her mastery of "Tetris," if there was an E.S.L. component that might account for  $P > V$  scores, and the date of the interview. None of this information was shown to any other colleague although a search of the files of all the children I dealt with would reveal the same results.

All the the children who responded negatively to the

independent variable, video game ownership, and who were not considered to have an E.S.L. background, were placed in the control group.

A stratified corresponding experimental group was chosen in the order that they appear on my data collection list with pairs matched by sex, year of birth, and community backgrounds. Fifteen pairs were from the same school and the remaining three were enrolled in schools situated close by.

#### Data Processing and Analyses

The statistical techniques used in answering the research question are both descriptive and inferential.

An interval scale has been used in the reporting of the instrument and the mean differences, medians, ranges, and standard deviations of both the control and experimental groups have been determined for the dependent variables - the Performance and Verbal I.Q. Scale scores of the WISC-R and the differences between them in each group.

An analysis of variance (ANOVA) has been used to examine the effect of the independent variable, videogame ownership/play, on the dependent variable, Performance Scores, Verbal Scores, and P - V differences, using  $p < 0.05$ , and follow up t-tests, which assess the significance, are reported.

### Methodological Assumptions and Limitations

The assumption has been made, in the study, that ownership and self-report did, indeed, mean that those in the experimental group had a higher level of videogame experience than those in the control group. Non-ownership/ownership of a videogame system and self-report of mastery of "Tetris" may not preclude sustained play, practice and mastery in the control group. However, personal experience and the literature indicates that mastery, at this age level, is achieved through ownership and that the hours of play, after acquiring a video system or new game, decreases over time (Creasey & Myers, 1986) while the mastery is not significantly diminished (Jones, 1984). Children who are allowed to use another's game for a short period of time are generally not allowed to spend the initial time investment required to master a game.

As reported, the parents of all the students in the control and experimental groups were advised of the information their children had provided, during the interview process, about their videogame experience. The parents were asked to contact me if the information was not accurate. I was contacted by only a few parents of children in the control group and no substantial differences in their children's self-reports of mastery were reported.

Therefore, there is also the assumption that the self-report of mastery of the game "Tetris" is a suitable differential between the two groups of students to question their P - V differences on the WISC-R.

The Nintendo game, "Tetris," requires that the player rotate successive tetrominoes (four squares joined together by at least one full side), either clockwise or counterclockwise, and translate (or slide) the figure to fill up negative spaces to make "lines." This particular game offers practice in the skill, mentioned by Kaufman (1979), of orientation or field independence.

One explanation of the attraction of games that demand orientation or field independence skills is some degree of innate sense of field independence on the part of the player. My assumption, deduced from the convergence of the performance test skills and the field independent game skills, is that eventually the fluid ability becomes crystallized so that the behaviour of the dropping tetrominoes becomes more predictable.

I suggest that "Tetris" is also a type of video game that provides the incidental learning (Kaufman, 1979) that develops this fluid ability. With practice, the learning, again, crystallizes and this ability is tapped in many of the performance subtests of the WISC-R. Knowledge of the tested child's video game background seems to offer another explanation for a  $P > V$  discrepancy, where no other factors



are apparent.

The incidental learning that comes with video game exposure, practice and, finally, mastery is actually in three parts, the first of which has been discussed. These are (a) field independence, (b) working within time limits, and (c) risk-taking.

All Performance subtests are timed, with bonus points awarded in many cases. Children who have difficulty working within time limits are also extremely penalized on the Performance scale. Children with video game mastery, especially in "Tetris," are quite familiar with working under time pressure. Often, video games have time factors built in. Time limits are set to get to higher levels and objects speed up in their appearance, especially in "Tetris." Immaturity, distractibility, reflectiveness, and compulsiveness are all factors that relate to poor performance on timed items in the Weschler Scales (Sattler, 1992). Videogame experience, however, bears a close relationship to the problem-solving ability tested in the timed performance aspects of the WISC-R and so, video games offer practice in the concentration needed under the pressure of time limits.

I also question whether video game players have tapped into the "evaluation" ability to make judgements in terms of a known standard explained by Kaufman (1979). Risk-takers can respond to stimuli when uncertain of the outcome. Video

players have experience in risk-taking and undergo the evaluation process constantly during the video game experience. Although trial and error and elimination are the problem-solving strategies usually used, early in the video game experience, especially in "Tetris," the ability to recognize patterns and predict desired spatial outcomes, with increased accuracy, eventually evolves into a needed skill to be successful at the game. Could it be that the practice effect of constant and immediate feedback improves the video game player's ability to make spatial judgements?

Of the nine subtests of the WISC-R that are considered good or fair measures of "g" or general intelligence, four Performance subtests measure abilities that appear to be convergent to the videogame processes I have just discussed.

Block Design, a Performance subtest, which is considered a good measure of "g" and is often looked at as the most important subtest in the identification of "giftedness," is subject to the influence of field independence and working under time pressure. It measures the individual's ability to analyze parts of the whole, to conceptualize non-verbally, and to visualize spatially. Mastery of "Tetris" depends on the development of these same abilities.

Object Assembly, Picture Completion and Picture Arrangement, three additional performance subtests, demand the abilities to work under time pressure, to

anticipate consequences and relationships, to respond when uncertain, and to have a strong sense of field independence. These abilities are also convergent to the ones used in "Tetris."

The question remains whether the background experience of videogame play and, in particular, the self-report of "Tetris" mastery is related to the development of skills tested in the Performance subtests of the WISC-R.

In the study, as designed, no measure of specific time spent in video game play or in attaining the self-reported mastery of Tetris was sought. There are also a number of other limitations which came to my attention largely after the data collection had been completed.

First, the research design was not truly experimental as the independent variable could not be manipulated; nevertheless, the composition of the experimental group has been closely matched to the control group to meet the requirements of the condition.

A second limitation considers the recommendations of Pepin and Dorval (1986) in terms of ensuring extended practice, multiple conditions, and convergent validity between the games and cognitive skills tested. Convergency between the actual video game and the spatial skills practised and tested has been discussed already but no systematic proof of that convergence was undertaken.

Third, the internal validity of the research may have

been jeopardized due to statistical regression towards the mean, since the population being dealt with, the gifted, lies in the extreme. However, the resulting data do not indicate this.

The fourth limitation, in terms of both replication and the size of my control group, was finding subjects with relatively little video game experience, which could result in little significant data, as in the case of Pepin and Dorval (1986). The sizes of the control and experimental groups are within accepted limits for such a research study, but the relatively small number of subjects and unequal groups of males and females made the examination of gender differences statistically weak and limited generalization to the population of interest.

The fifth limitation may be that the interviews that were conducted during the screening procedures for the gifted program had experimenter bias as I was working towards a specific result. However, I believe that the integrity of the process was maintained despite the time it took to locate the control group.

Finally, the question of external validity of the results of the WISC-R measure continues to be an important one. Does the WISC-R measure, with reliability and validity: (a) the actual analytical non-verbal, spatial skills of the child, (b) the practice effect enhancing spatial skills that are reflected in the Performance I.Q.

scores, and/or (c) a practice effect that simply inflates the Performance I.Q. scores?

#### Restatement of the Problem

Is there a videogame effect on Verbal and Performance I.Q. Scores? Is there a greater difference between the Performance and Verbal I.Q.'s of high functioning students who own and have played on a sustained basis video games relative to those who do not own or play video games with regularity? Does the mean difference of those who own video games exceed the accepted difference between Verbal and Performance I.Q. before statistical significance is considered?

## CHAPTER FOUR: FINDINGS

### Results

Means, medians, ranges, and standard deviations, by sex and group, of the Verbal Scores, Performance Scores, and the Performance I.Q. Scores minus the Verbal I.Q. Scores are presented on tables.

Means, medians, ranges, and standard deviations, by sex and group, of the Performance I.Q. Scores minus the Verbal I.Q. Scores are presented in Table 1. Differences in the mean P-V discrepancies in the control and experimental groups are also included in Table 1. Several significant results are evident in these descriptive data.

In the control group, the mean Performance score was 2.11 I.Q. points below the mean Verbal score with a Standard Deviation of 10.59 points. In the experimental group, the mean Performance score was 13 I.Q. points above the mean Verbal score with a Standard Deviation of 10.16 points. The overall difference between Performance Scores and Verbal Scores, was 15.11 I.Q. points for the experimental group over the control group.

The analysis of variance (ANOVA) yielded a very significant difference by the condition [ $F(1,34) = 19.707$ ,  $p < .001$ ] such that the experimental group, those who own

Table 1

Performance I.Q. Scores Minus Verbal I.Q. Scores:  
Means, Medians, Ranges, and Standard Deviations by Sex and  
Group

Control Group	M	Median	Range	SD	n
Female	-3.23	0	48	11.85	13
Male	0.8	1	15	6.38	5
All	-2.11	0	48	10.59	18
Experimental Group	M	Median	Range	SD	n
Female	10.61	12	35	9.13	13
Male	19.2	14	27	11.03	5
All	13.00	13	51	10.	18
Difference =		Female	+13.84		
		Male	+18.4		
		All	+15.11		

and play a video game system with regularity and have skill at "Tetris," had a greater difference between Performance and Verbal Scores than the control group, those who did not own or play with regularity a video game system ( $t = 4.439, p < .001$ ).

Means, medians, ranges, and standard deviations by sex and group, including differences, of the Verbal I.Q. Scores are presented in Table 2.

A second significant result regarding Verbal I.Q. Scores in both groups, that was not anticipated and was yielded by the ANOVA, was the greater Verbal I.Q. scores in the control group [ $F (1,34) = 14.055, p < .001$ ] such that no video game ownership/play was associated with higher Verbal scores than video game ownership/play ( $t = 3.749, p < .001$ ). The difference in the mean Verbal scores between the control and experimental group was 12.17 I.Q. points.

Means, medians, ranges, and standard deviations by sex and groups, including differences, of the Performance I.Q. Scores are presented in Table 3. The ANOVA did not yield a significant difference in Performance I.Q.'s between the two groups [ $F (1,34) = 8.46, p < .364$ ]. Therefore, the P - V differences are a result of the relative Verbal I.Q. Scores in each group.

An examination of the table indicates that there is a slight difference, 4.38 I.Q. points, in the



Table 2

Verbal I.O. Scores: Means, Medians, Ranges, and Standard Deviations by Sex and Group

Control Group	M	Median	Range	SD	<u>n</u>
Female	131.15	133	36	10.01	13
Male	134.20	135	32	12.03	5
All	132.00	133	43	10.33	18
Experimental Group	M	Median	Range	SD	<u>n</u>
Female	121.69	122	25	6.70	13
Male	115.20	125	34	13.36	5
All	119.83	122	39	9.12	18
Difference =		Female	-9.46		
		Male	-19.00		
		All	-12.17		

Table 3

Performance I.O. Scores: Means, Medians, Ranges, and Standard Deviations by Sex and Group

Control Group	M	Median	Range	SD	<u>n</u>
Female	127.92	131	41	13.06	13
Male	135	133	19	8.63	5
All	129.88	131	41	12.19	18
Experimental Group	M	Median	Range	SD	<u>n</u>
Female	132.31	131	26	6.43	13
Male	134.2	133	14	5.22	5
All	132.83	131	26	6.03	18
Difference =		Female	+4.39		
		Male	-0.8		
		All	+2.95		

Performance Scores of the females in the experimental group over those of the control group. However, this showed no statistical significance [ $F(1,24) = 1.575$ ,  $p < .219$ ].

It should be noted that the Standard Deviation of the control group showed greater variability in the Performance Scores than that of the experimental group and that this was particularly noticeable in the female condition. As well, the Standard Deviations of the control group showed greater variability in the Verbal Scores than the females of the experimental group and the variability in the Verbal Scores of the males of the experimental group was even larger than that of the control group. However, no interactions between the effects of gender and video game play could be examined as the  $n$ 's were too small and unequal for a statistical foundation.

In summary, two findings stood out from the inferential statistics. As anticipated, the mean Performance I.Q. score was markedly higher than the corresponding mean Verbal I.Q. score in the video game owning/playing experimental group. The mean difference was 13.00 I.Q. points and this is considered statistically worthy of an explanation by Kaufman (1979).

The second important result that was not anticipated, was that the non video game owning/playing control group scored a mean of 12.17 I.Q. points higher on the Verbal

scale than the experimental group. This is also worthy of an explanation.

### Interpretation of the Findings

Although the hypothesis has been confirmed, the underlying explanation is in question. From the data, it might be interpreted that the ownership and play of video games produced the anticipated results. However, in addition to the discovery of a  $P > V$  difference in the experimental group between their scores, a significant depression of the Verbal Score of the experimental group relative to the control group, was also apparent and this was not anticipated.

Those students who did not own or play video games, the control group, had mean corresponding Performance and Verbal I.Q. scores with very little discrepancy or difference and a valid mean Full Scale score. All mean scores clustered around the I.Q. score that indicates Very Superior Intelligence (130 points) and reflected the expected profile of gifted candidates. Kaufman (1979) felt that exceptional school achievement is reflected in a high Verbal I.Q. and overall the Verbal I.Q. was 2.12 points higher than the Performance I.Q. in the control group.

The students who did own and play video games, the experimental group, showed a significant mean discrepancy or

difference between the Performance and Verbal I.Q.'s of 13 points. Although the mean discrepancy was under 15 I.Q. points and a valid Full Scale Mean I.Q. could theoretically be developed, the size of the difference required for statistical significance ( $p < 0.05$ ) is 12 points (Kaufman, 1979).

The mean Performance I.Q. Score of the experimental group was also close to the score that indicates "Very Superior Intelligence" and three points higher than the control group. However, as previously reported, the mean Verbal I.Q. score of the experimental group is at the very top end of the "High Average" range and a full 12 points lower than the control group.

Performance over Verbal ( $P > V$ ) discrepancies signify quite different things for different individuals and the individual discrepancies in the control and experimental groups vary. Videogame play may be a common factor but other possible explanations need to be examined.

A positive difference between the Performance I.Q. score and the Verbal I.Q. score ( $P > V$ ) was seen in 17 of the 18 subjects (94%) of the experimental group, those who owned and played video games. In only seven of the subjects (39%) in the control group, non-video owning children, was  $P > V$  evident and only one of the 18 subjects (5.5%) had a  $P > V$  difference considered statistically significant by Kaufman (1979).

The difference in the mean verbal score of the experimental group relative to the control group must be taken into account when interpreting the data. The children from the experimental group had also achieved success within the classroom environment but, in only one case was the Verbal I.Q. score within the Very Superior range.

Although this difference in Verbal I.Q. may be ascribed to the time spent away from language based pursuits due to a video game interest, it may also reflect a preference in learning styles. Child-centred learning and active learning environments (Schwartz & Pollishuke, 1990), which are much more popular in our classrooms today, better provide for those children with an interest in doing (i.e., exploring, demonstrating, designing, creating, and constructing) while still nurturing those children with a stronger language based preference.

Teachers are better informed about the behavioral characteristics that may indicate giftedness and they are taking into account creativity and problem solving ability in addition to conventional school achievement when nominating students for the gifted program. The recognition of fluid ability in children may be increasing through classroom activities that address right brain strengths (Kaufman, 1979). The increased use of concrete, manipulative materials in learning help to channel strong fluid ability and develop crystallized ability. This may

account for the fact that the students in the experimental group were also considered as gifted nominees even though their high achievement in the classroom was not reflected by Very Superior Verbal Scores. In the past, Verbal Scores were more closely related to classroom achievement than Performance Scores.

The results confirm that, as a group, the children in the study who play video games, as a group, showed significant differences between their Performance and Verbal scores ( $P > V$ ). These results suggest further examinations of whether these children already had better developed fluid and spatial abilities, of whether these abilities were developed as the result of video game play and practice, of whether preferences in right brain processes affected verbal test results negatively, or of whether language abilities were not as crystallized due to the time spent in videogame play.

Furthermore, there exists the possibility that along with improvement in spatial skills, the experimental subjects developed an increase in motivation when dealing with the concrete-visual stimuli of the Performance subtests. It is also possible that success in facing the tasks required on the Performance subtests could be attributed to their reduced degree of fear of failure.

## CHAPTER FIVE: SUMMARY, CONCLUSIONS, AND IMPLICATIONS

### Summary

As the use of home video games has increased in our society, I have observed an increase in the difference between Performance I.Q. scores and Verbal I.Q. scores ( $P > V$ ) in high functioning students who were being tested with the WISC-R for purposes of gifted identification.

I am concerned that this discrepancy is, at least in part, due to a video game practice effect and the purpose of this study was to explore the relationship between video game play and scores on non-verbal tests of spatial aptitude. This exploration was accomplished by an examination of Verbal I.Q. Scores, the Performance I.Q. Scores, and the differences between Performance and Verbal I.Q. Scores of high functioning junior grade children who did own and play video games and those who did not own and play video games.

A review of the educational literature in Chapter Two, dealing with the videogame experience, yielded interesting speculation and a growing body of qualitative and quantitative research. Early articles dealt with the lure of videogames, the educative benefits of videogames, and implications for the future. Educators were urged to "buy in" to the educational applications and not to miss this opportunity the way they did with the new television media.



The researchers agreed that gender differences do exist both in general spatial aptitude and interest in video technology. However, some research indicates that spatial skills can be taught, at an early age, and that if girls are given the opportunity to play video games, these learned skills can be transferred to content areas such as mathematics, science, and engineering.

No hard data were found which justified condemning the personal use of video systems based on anti-social behaviour. Children tend to put a large outlay of time into a system when they first receive it, but the playing time diminishes as mastery is achieved. Normally this playing time is borrowed from other media activities such as television and radio and there appears to be little impact, in general, on peer relationships or school achievement.

A number of studies have been completed on the positive impact of interaction with video games on both the development of spatial skills and the potential practice effect. These studies are mainly with adult populations (college students, seniors) and the ones dealing with children have either been inconclusive or interested in learning disabilities.

This study has given an extensive description of Kaufman's (1979) analysis of the Performance and Verbal discrepancy in the WISC-R. Although Kaufman's investigation was published some time ago, much theoretical foundation for

the video practice effect lies within his analysis.

Chapter Three discusses methodology used in this study. The subjects were chosen from pre-existing conditions in which I am professionally involved and the data were collected over a period of six months. Important assumptions concerning video game ownership as the independent variable and the similarities between the video games played and the skills tested in the Performance subtests of the WISC-R have been addressed along with other limitations of the study.

The results of the study are given in Chapter Four. Statistically, the hypothesis has been confirmed but analyses of variance yielded other important data and the limitations of the study must be considered. Videogame play appeared to be an important variable. The small and unequal numbers of male and female subjects meant that the gender factor could not be discussed. Although the differences between Performance I.Q. and Verbal I.Q. were larger ( $P > V$ ) in the video owning/playing experimental group, their Verbal I.Q.'s were considerably lower than the control group. At the same time, the Performance I.Q.'s of both groups showed no significant differences.

## Conclusions

The hypothesis of this research study concerns the effects of video game practice on spatial aptitude scores of high functioning children. A difference between the Performance and Verbal I.Q. Scores of these children who own and play video games on a sustained basis, greater than the difference between Performance and Verbal I.Q. Scores of children who do not own and play video games, has been discovered. However, considering the relative depression of the mean Verbal I.Q. Score in the experimental group, this difference raises a number of questions, including the cause of lower verbal scores.

If spatial scores are affected by video game play, has the ability become enhanced or, simply, inflated? Are verbal scores retarded when there is enough videogame play to attain mastery? Is there a potential in videogame play to improve spatial aptitude in high functioning children?

Children who did not have practice in video games had relatively comparative scores in the Verbal and Performance I.Q. scales on the WISC-R. Children who owned video games and played "Tetris" scored a significant difference between Performance and Verbal I. Q. scales. The mean difference ( $P > V$ ) was considered worthy of an explanation, and the video game practice effect could be part of the explanation.

The question that remains unanswered, in light of the

relatively weaker Verbal I.Q. scores of the experimental group, is whether or not the video game experience and practice effect also includes a depression of the Verbal I.Q. Previous research does not address this problem although several studies looked at the potential of video games to improve word recognition skills and dismissed any negative effect on school achievement (which is often reflected in high Verbal I.Q. scores).

The query concerning the nature of the video game practice effect, whether it actually enhances spatial ability, enhances spatial skill scores, or inflates these scores, has been addressed, at least in part, by both the literature and the recognition by classroom teachers of both the children in the control and experimental groups, as gifted.

Evidence exists that spatial ability can be improved with instruction. Games that require player manipulation or the rotation of objects, with repetition, lead to the development of spatial skills (Lowery & Knirk, 1982).

Recognition of the video game practice effect, when the P - V discrepancy is opposite in direction to the typical findings for a high functioning children without any socio-economic disadvantages, is important for the researcher and the clinician. As well, the possible retardation of the relative verbal scores has been given consideration when interpreting both the test scores and the

results of this study.

The subjects in the both the control and experimental groups in this study were, in most cases, identified by their classroom teachers as having gifted behaviours. If the strengths of the video game players lay in the areas of perception, analysis, synthesis, and concept formation (skills tested by the Performance scale of the WISC-R) rather than language development, then the measured level of their cognitive functioning was commensurate with their classroom behaviour and school achievement.

Since research indicates that video game skills are maintained over long periods of time, a reasonable assumption might be that spatial ability has been enhanced, by video game play, beyond the corresponding verbal levels and that learned factors such as speed, risk taking, and field independence have affected their achievement in a number of learning situations. Furthermore, without the video game practice, these children could well have remained in a Performance I.Q. level that corresponded to their Verbal I.Q. level (the upper end of the "High Average" range) and they would likely have not been considered for identification for purposes of the gifted program.

Other possibilities must be considered as well. When a child scores in the "Very Superior" (Gifted) range on a performance scale in intellectual testing and this does not seem to parallel classroom performance and intellectual

functioning, the child's video game background should be considered. If the child's verbal score in intellectual testing appears to fall below expectations, the videogame factor should be weighed.

As well, a right brain cognitive style, discussed earlier in this study, is adept at handling non-verbal stimuli with relative ease. However, such a style may be unable to shift, with similar ease, into the sequential mode necessary to interpret verbal directions and the verbal subtests and may put youngsters at a disadvantage, overall, in test situations. Children that have predispositions, for whatever reasons, to activities challenging their spatial skills may inadvertently reduce the amount of time spent on activities of verbal interaction and reasoning, required to equally develop a left brain cognitive style. In both of these cases, the video game interest may come from a natural preference in learning style and the results of these children in test situations would not be attributed to their video game practice; their video game interest, their strong Performance Scores, and their relatively weaker Verbal Scores would all stem from a preference for and subsequent time investment in activities requiring holistic spatial skill.

If one accepts the hypothesis that the videogame practice effect has been responsible for the relative increase in Performance I.Q.'s in the experimental group,

given that there is evidence in the literature that videogames have the potential to enhance spatial ability, there still is quite a lot of uncharted territory to cover. As the variety and complexity of video games increases and the requirements for system upgrades (to handle "virtual reality," on-line play, and other video gadgetry) continually grow, this territory will expand. However, certain areas can be discussed, today, that affect high functioning children.

There was no statistical foundation for an examination of the interaction between gender and the independent variable in this study. However, of the 18 subjects in the control group, those who did not play video games, 13 of them were girls. (This could be misleading because I spoke to many girls who did own video games and I had no difficulty finding 13 female video game players for the experimental group.) The literature indicates that video technology, in any form, is not as popular with girls as it is with boys and that girls continually are under-represented in the fields of math, engineering and science. When the correlation between high spatial ability and mathematical and scientific ability is considered along with the assumption that spatial skills instruction at pre-puberty is the most effective (Lowery & Knirk, 1982), it becomes apparent that video game play should not necessarily be discouraged in all children at an early age.

As well, many types of video games provide the ideal context for the development of thinking and problem solving skills. The concepts of built in evaluation and immediate feedback are important here as children learn to take calculated risks without fear of failure. Children are also given practice in staying on task, reading for a purpose (both on screen and in video print media), recording skills (i.e., charting information), study and research skills (some games demand outside research to answer questions or make choices), mathematical skills (besides making rows with tetrominoes, the concepts of time, distance, scale, vectors, and geometry are used in many games), keyboarding skills (which increases their confidence in using a computer), and speaking and listening skills (children discuss, among themselves, the strategies one must use to reach a higher level).

Early studies on video games indicated that business could not be depended on to develop games that would benefit a child's education. As the home market peaked, the educational market has strengthened. Early sales had been disappointing but the success of companies such as "Sierra" and "Broderbond" have made other large software companies sit up and take notice. The new educational products are slated for both home and schools and deliver a high level of entertainment as well as curriculum, organizational, and problem-solving benefits.



Perhaps Ball's (1978) and others' early claims that video games could teach communication and word recognition skills, creativity, and numerical concepts, in an entertaining and systematic way, were more than mere speculation and have important implications for gifted education, and for education, in general.

#### Implications for Practice

We are teaching a new generation of children whose environmental experiences differ markedly from those of their teachers and their parents. The reliability and validity of traditional test instruments used on this new generation of children are worth increased attention. The implications that the amount of time spent playing video games can improve spatial skills, that these skills can be applied to new kinds of learnings in the classroom to both further develop spatial abilities and remediate verbal skills, that girls will benefit even more than boys from these early experiences, and that such skill improvement can transfer to subject areas within the curriculum are also worthy of attention within a theoretical and practical framework.

The Weschler Intelligence Scale for Children was revised in the 1970s when norms and cultural bias factors were considered out of date. Kaufman (1979) saw a very real

possibility that children who were classified in the "Very Superior" range (gifted) on the WISC would achieve levels only in the Superior range on the WISC-R. The 1990s have brought us the WISC-III and it has been implemented in our school board in the 1992-1993 year. Assessment with the WISC-III, with new norms, would likely have affected both the control and experimental groups of students who scored just within the "Very Superior" range on the Performance scale of the WISC-R.

Sattler (1992) has taken over from Kaufman in the data analysis of the WISC-III. He reports that in a predictive validity study undertaken to compare the WISC-R to the WISC-III, the Full Scale I.Q.'s on the WISC-III were 4.9 points lower than those on the WISC-R, with a sample of 23 gifted children. However, the I.Q.'s on the Performance Scale were only lower by 1.1 points in gifted children.

It is also very likely that many students in the experimental group would never have attained the requisite levels of Performance Scores required for gifted identification had they not been experienced in videogame play. I suggest that the results of the Performance subtests developed to indicate degrees of spatial and perceptual organization skills are now affected by the background of video game experiences, likely at all levels of intellectual ability, and that such a background becomes a prime consideration in interpreting the V-P discrepancy,

no matter what the version of the test.

Sattler (1992) sees the WISC-III as having a limited floor and ceiling in that it is not applicable for severely retarded or gifted children. He also feels that large practice effects exist on the Performance Scale, in retest situations.

All of these factors contribute to an uneasiness about the appropriateness of the WISC-R or WISC-III as a true measure of spatial and perceptual organization skills and the use of the Performance Score as an indicator of giftedness when the video game practice effect is taken into account. Sattler agrees that the child's Performance I.Q. may be affected by factors such as motivation, interests, cultural opportunities, attention span, and the ability to process visual information and he says that all of the Performance subtests place a premium on speed. The possibility that all of the above factors may be related to video game experience has been discussed.

If children who already achieve at an above average level in the classroom can increase their visual/spatial skill development through sustained video game play, what effect will the video game experience have on average or below average learners? Will enhanced test scores reflect their potential in educational settings or simply reflect a practice effect? Do less effective learners have the same ability as high functioning children to transfer skills from

one context to another? Is mastery of a video game related to intellectual ability so that high functioning children get extra benefits from the video game experience? Clearly, knowledge of the video game experiences of a child in an assessment situation, where tests of spatial and perceptual skills are included, is critical.

The question remains concerning the appropriateness of the WISC-R and WISC-III as measures of giftedness and criteria for requiring a differentiated program. However, most other tests of cognitive ability contain both verbal and non-verbal measures and the practice effect impacts on most of these traditional test instruments. The possibility exists that video games be developed, for test situations where the subject has video game experience. If this were the case, those children who did not have extensive experience in video game play would not be disadvantaged in any way by conventional testing.

The high functioning children of the control group in the study did not, generally, have any interest in videogame play. Certainly, they did not appear disadvantaged by conventional testing. Their mean performance skills lay in the Very Superior range without videogame intervention. It would be interesting to look at their attitudes to videogame play given their already well developed visual/spatial skills. Perhaps, the possession of these highly developed skills by students like those in the control group affects

their desire to acquire greater mastery. This would be analogous to a natural soprano not wanting to sing repetitive musical scales. Instead, the singer might want to become involved in the composition of music. In the same way, a child with already "Very Superior" visual/spatial skills may be more interested in programming on the computer or being involved in the new, true, interactive technologies rather than simply playing videogames.

Performance Scores measure many types of incidental learning and possibly the high functioning children of the control group had a more integrated left brain/right brain approach to the tasks on the WISC-R. Other computer activities that offer visual/spatial practice (graphing, designing objects in two and three dimensions, paint programs, etc.) may have been undertaken by the control subjects (no data was collected on this aspect). In other words, the control and the experimental groups in this study may be composed of two very different types of learners with different interests and predispositions to learning and leisure.

Fortunately, the assessment process for gifted students (in fact, all students with special needs) takes into account far more than I.Q. Scores from psycho-educational testing. Test authors spend considerable time advising clinicians of other behavioral and academic factors that are to be considered. Convergency of both objective and

subjective data is always sought when making an identification of special needs. Nevertheless, it appears that the videogame factor should be flagged and regularly considered when interpreting tests of ability.

Some evidence does exist that exposure to the new interactive video media has some positive effect on the results of tests that measure spatial ability and perceptual organization. It follows that a generation of youngsters who play video games as normal, developmental behaviour will likely have increased ability in manipulative problem solving and that our curriculum should reflect this change.

All learning environments, and specifically those in gifted education, should encourage the use and development of these concrete analytical skills. Programs should focus not only on verbal, left brain, and crystallized learning, but they should integrate the styles of both cerebral hemispheres. No longer is school achievement (which has been reflected in the Verbal scale of the WISC-R) accomplished by intensive, mostly rote learning, where communication is done mainly verbally. The abilities to cope with intellectual surprises, activities that do not have prescribed outcomes, divergent thinking, and the use of an inquiry or problem-solving model, across the curriculum, all have equal value to convergency, regurgitation, and repetition.

Although our gifted programs have long stressed

creative problem solving and the development of higher level cognitive skills, traditionally much of the work has been done in the verbal mode. If a large percentage of gifted students are stronger in the manipulative mode, more concrete and visual stimuli, especially at the elementary level of gifted education, should be used.

The learning comes full circle when the computer provides opportunities to organize data visually in graphs, data bases, and spreadsheets, to create objects in two and three dimensions through programs like "Logo" and "Tab," to use interactive programs that offer practice in deductive logic and problem solving, and to utilize word-processing programs that encourage the growth of verbal skills through such utilities as spell check, thesaurus and grammar evaluation.

The literature shows that individuals who play video games can increase their problem-solving and spatial ability and, thus, have certain intellectual advantages. Parents and teachers must be informed of this possibility.

I have had direct dealings with teachers, in mathematics problem solving and manipulative workshops, who are vocal in their opinions about the continued value of "conventional" textbook teaching and who believe that the video game experience skills that students bring to the classroom are to be ignored, especially if they cannot yet read or write at the expected level.

In the spring of 1992, I attended a "Futures" conference where an auditorium full of teachers was asked to indicate, through a raise of hands, who owned a home computer. I was shocked to see only about 10-20% (which is no more than the general population) of the hands raised. My experience indicates that the use of the computer is often left, by classroom teachers, to the experts or treated as a once a week learning situation where traditional teaching methods are used to teach in a non-traditional learning situation.

Parents, generally, are unsure about the value of video game systems and the use of the home computer for games. The personal ownership of a video system does not seem to be as much an economic issue (although the size of the game collection may well be) as an issue of values. William Burrill (February, 1992), who writes a weekly column called "Electronic Games" for the Toronto Star, discussed the problems that children and their parents run into when establishing time limits for video game play and he suggested to the public that video games should be used as rewards for kids, not a substitute for life, and that banning games would make the activity even more attractive to children and/or force them into the arcades. Would it not be of more use to let parents know which games have the best mixture of educative and entertainment value and that the playing of those games has the potential of increasing



their child's visual/spatial aptitude?

There is evidence in the literature that video games can be operated by young adults with severe mental handicaps and that this skill is partially maintained over time (Duffy & Nietupski, 1985) and that incarcerated juveniles benefit from the instant feedback of video games which provides personal reinforcement (Kappes & Thompson, 1985). As well, a study involving three young children with multiple handicaps showed that scanning skills learned from a video game system could be transferred to a communication device (Horn, Jones, & Hamlett, 1991).

Although the above evidence is by no means conclusive, it certainly points in the direction that the acquisition of spatial skills through video game practice is by no means confined to high functioning children and that these skills can be accessed by a wide range of intellectual abilities.

Additional skills that can be developed through video game systems have already been mentioned. The list covers skills mentioned in all Ministry of Education for Ontario documents and school board curricula: reading, recording, research, mathematics, keyboarding and communication skills. Not only can these skills be taught in classrooms using appropriate video software but they can be introduced and reinforced in the home with relatively low stress factors!

Video game systems can be found in a large portion of homes with children in North America. Over 85% of the

children I interviewed this year owned some sort of dedicated system. As educators, we can not afford to ignore such a resource in a country that is clamoring for advanced technologists, scientists, engineers and applied mathematicians.

Educators in Ontario are especially concerned that many girls drop out of mathematics in Grade 10 when the subject becomes optional. Crawford (August, 1992) tells us that girls are outnumbered two to one by boys in most advanced level mathematics graduating classes and that girls comprise only 35% and 46% of all physics and chemistry students by the senior year. Crawford says that scientists estimate that over 300,000 graduates in science and engineering will be needed in North America by the year 2000 and that the pressure is on the school system to keep girls interested.

Mathematics is considered the gateway to the study of all the sciences and Ontario universities have started pitching math and science programs to Grade Nine students. There are beliefs that girls have not been given enough career information and that girls consider math to be for "nerds."

However, a study released in July, 1992 by professor Nancy Mandell, reported by Crawford (August, 1992), concerning gender differences in schools in Mississauga, Guelph, Edmonton, and Ottawa showed that girls felt a bias existed within the school system against the pursuit of

math, science, physical education, and business courses. Female students were both reported to have faced sexist remarks about problems they were having in mathematics classes and to have been asked less often than boys to work at the blackboard in the front of the class.

The Ministry of Education in Ontario is rewriting the entire curriculum for Grades three, six, and nine and part of this objective is to analyse gender bias in textbooks (Crawford, 1992). Currently, many of the applied problem solving questions in textbooks naturally favour the male learners as they are often questions involving automobile speeds and distances, sports arenas and fields, and the purchase of fast food and sports equipment - all areas with which boys are generally more familiar.

Crawford reported that the 1992 Canadian Mathematics Competition results showed that only two girls managed to make it in the top 25 achievers and, although 48% of the participants were girls, only 11 of the top 97 students were girls. Again, girls are less likely to favour competitive situations, the context in which mathematics achievement is most often noted. Math is considered a risk taking subject as there are situations where it is unclear how to proceed and society has raised boys to be more aggressive and willing to take risks.

Crawford (1992) also reported studies of mechanical drafting classes where spatial skills are important and

stated that although girls initially did poorer than boys, with practice, they did as well as the boys. As well, she mentioned the importance attached to field sports as ways of teaching spatial skills and the reluctance of girls to become involved. (A look at television sports coverage will offer few role models for girls in field sports.)

I suggest that ensuring that young girls participate in the video game experience, in a non-competitive way, could increase the female interest and representation in math and science. Video games encourage both risk taking and field independence (spatial skills) and I have offered testimony that pre-pubertal instruction in spatial skills is the most effective for children. There is also evidence to indicate that spatial skills can be developed through instruction and that this improvement can be linked with preference and performance in math and science. What better way to enhance the spatial ability of all children, but especially girls who do not get natural training developmentally, than to encourage the use of appropriate computerized video technology?

Unfortunately, as previously mentioned, most of the adventure type video games are designed for males by males. The majority of video game contexts or environments are battles, sports, medieval castles and lands of superheroes. I am not suggesting we create "The Legend of Barbie & Ken"; the new crop of learning games does include environmental,

fairytale and travel contexts. Nevertheless, a more skilled marketing program could be used to make video game play more attractive to young girls. Interest in video games drops off quickly as females approach adolescence, so the video game intervention must happen in the primary and junior grades.

Both the home and the school can foster this spatial instruction masked in game play and my guess is that the large video hardware and software companies would welcome support and endorsement from the academic community in the development of new products that address the young female mentality.

#### Implications for Further Research

The anticipated outcome of the research study was the increase in the Performance I.Q. over the Verbal I.Q. in those children who owned and played video games on a regular basis.

Two outcomes were not expected. Those children who owned and played video games scored lower on the Verbal I.Q. Scale than the corresponding group of children who did not own and play video games. There was no increase in the overall Performance I.Q. of the experimental group compared to the control group.

I have speculated on this information and suggested

that the video playing children were selected for nomination to the gifted program because of their strengths in the perceptual, analytical, and manipulative elements of today's classroom curricula. I have also suggested that their stronger spatial skills could be used to improve their verbal skills, given the appropriate intervention.

Although I kept no data in this area, I recollect from my talks with some of subjects in the control group, that video game systems were frowned upon by the parents and that they preferred their children to grow up with a more traditional approach to leisure time. Family time, reading, group board games, and just plain talking with each other were typical of the interactions mentioned. In the control group, there was no diminishment of the Performance I.Q., as might have been anticipated, relative to the experimental group or the Verbal I.Q. of the control group. Future qualitative research could examine the attitudes and interests of students whose Very Superior Performance Scores have not been subject to extended video game exposure. As well, a qualitative analysis of students with, and without, the  $P > V$  difference, at a variety of levels of ability, could be undertaken to explore their backgrounds in activities requiring verbal interaction and in language based pursuits.

The finding that the possible enhancement of performance skills through the video game practice effect

may also have some negative impact on relative verbal skills does merit further research, especially in a population of high functioning children. The outcome of such research could be beneficial to populations of all intellectual abilities. It would be wonderful for parents and educators to be reasonably sure that directed video game experiences would have a growth effect on spatial skills without an accompanying verbal suppression, should the research point in that direction. The opposite finding would also be of great use.

Another area that might offer insight into the practice of educators is the failure or reluctance of teachers to buy into new technologies, whether it be personal computers, computers in the classroom, or the use of educational video games in the classroom. If classroom teachers are going to lead their charges into the technological age, what biases have to be overcome before this direction is taken?

Finally, the issue of gender in the video game experience can be studied from a number of different perspectives. The literature indicates that girls differ from boys in potential spatial ability and interest in the new video technologies. Will encouraging their experimentation at an early age result in an interest and the transfer of spatial skills later on? Will it significantly alter their socialization and their roles of nurturer in current society? Will the practice in spatial

reasoning, through video game intervention, produce different results in girls than it appears to in boys?

Any future studies on the effects of the video game experience may suffer from the limiting difficulty of finding a large enough population of children who do not play video games, at least in the developed areas of Canada and the United States. Researchers Pepin and Dorval, noted this problem in their study of 1986 and I was somewhat surprised to discover as small a control group as I did. Future studies may consider collecting data from the past or from demographic areas where the video game factor is very low. Furthermore, the effects of other games that may impact on spatial skills, such as chess, could be explored using a true experimental design where conditions of random sampling and post and pre tests could be met.

Although limiting factors do exist, the popularity of personal video games appears to be more than a passing fancy. Systems are becoming more sophisticated, the public is becoming more computer friendly, large volumes of dollars are being spent on the marketing of the systems, and, like television, video games and their implications are likely here to stay.



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APPENDIX A: Questionnaire used as a guideline during the interview of potential gifted candidates.

GIFTED INTERVIEW QUESTIONNAIRE

NAME \_\_\_\_\_ DATE \_\_\_\_\_

SCHOOL \_\_\_\_\_ GRADE \_\_\_\_\_ AGE \_\_\_\_\_ SIBLINGS \_\_\_\_\_

PARENT'S NAMES \_\_\_\_\_ LANGUAGE AT HOME \_\_\_\_\_

OCCUPATIONS \_\_\_\_\_

1. Favourite school subject(s)?

Least favourite?

What do you like best about school?

What do you like least?

How might you change things in your class/school?

2. Extra curricular activities in/out school.

Memberships in clubs/organizations.

Hobbies/interests? (kind; length of time)

3. If you had 1/2 day of free time to study any topic you wanted?

a) topic \_\_\_\_\_ details \_\_\_\_\_

b) information \_\_\_\_\_

c) presentation \_\_\_\_\_

4. Favourite reading materials? (kind, quantity)

Magazines/Newspapers? (kind, parts)

Television Programs? (favourite, news, how much)

Current issues, topics in media? Significance?

5. Current jobs/responsibilities?

Home -

School -

Educational ambitions/career goals?

Most important elements of a chosen career?

Good leader/follower?

Enjoy it?

Recent experience?

Characteristics of a good leader?

6. Enjoyment of projects?

Recent success?

Individual?

Group?

Inventions?

Awards?

Favourite forms of recreation (games, family activities?)

Trips outside of Ontario?

Personal choice?

Value?

7. Name 2 things you would do if you were Prime Minister of Canada:

8. Interest in Gifted Program?

Parent's feelings?

Keeping up 1 day a week?

## Footnotes

1

This question, asked during the interviews of all the candidates being assessed for the purpose of identification and placement in the gifted program, was expanded as explained in the study. Students were discreetly asked about their interest in videogames, ownership of a system, and mastery of "Tetris", along with their interests in other kinds of games (board, outdoor, cards, etc.)

APPENDIX B: Letter to parents of control subjects.

Dear Parents,

When your child was assessed for the purpose of gifted identification, s/he was interviewed to ensure that his/her learning style and interests made consideration for placement in the gifted program appropriate.

One of the questions I always ask children, in this context, is the kinds of games they enjoy playing. In the last few years, I have observed an increase in the play and ownership of personal video games and this interest was discussed with your child.

Currently, I am working on my Masters of Education degree and I am looking at the effects of video game play on the spatial skills of children.

Spatial skills are measured by the Performance scale of the Weschler Intelligence Scale for Children - Revised (WISC-R), the test your child was given as part the the gifted assessment process.

I would like to use your child's data (specified above) in my research study. No names, schools or actual individual I.Q. scores will be used and I am mainly interested in the difference between the Verbal and Performance scores.

During the interview process (which occurred early in 1992), your child indicated that s/he did not own nor have immediate access to a video game system and that s/he had not developed any skill at a video game called "Tetris".

If you would like to obtain further information on the study or if the information I have regarding your child's video game use is not correct, please call me at home (822-4732) or at my office (393-5402) at your earliest convenience.

Thanking you in advance for your interest and consideration, I remain,

Yours truly,

Mary-Jane Jones  
Special Programmes



APPENDIX C: Letter to parents of experimental subjects.

Dear Parents,

When your child was assessed for the purpose of gifted identification, s/he was interviewed to ensure that his/her learning style and interests made consideration for placement in the gifted program appropriate.

One of the questions I always ask children, in this context, is the kinds of games they enjoy playing. In the last few years, I have observed an increase in the play and ownership of personal video games and this interest was discussed with your child.

Currently, I am working on my Masters of Education degree and I am looking at the effects of video game play on the spatial skills of children.

Spatial skills are measured by the Performance scale of the Weschler Intelligence Scale for Children - Revised (WISC-R), the test your child was given as part the the gifted assessment process.

I would like to use your child's data (specified above) in my research study. No names, schools or actual individual I.Q. scores will be used and I am mainly interested in the difference between the Verbal and Performance scores.

During the interview process (which occurred early in 1992), your child indicated that s/he owned or had immediate access to a video game system and that s/he had developed some skill at a video game called "Tetris".

If you would like to obtain further information on the study or if the information I have regarding your child's video game use is not correct, please call me at home (822-4732) or at my office (393-5402) at your earliest convenience.

Thanking you in advance for your interest and consideration, I remain,

Yours truly,

Mary-Jane Jones  
Special Programmes