

**An Assessment of a Mental Imagery Intervention
for Primary School Children**

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the degree of Masters of Science**

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Abstract

An intervention designed to develop mental imagery skills was implemented in a primary school setting for children from grades 1 to 6. Children were separated into control and experimental groups and pre- and post-test measures were taken to determine the effects of the intervention on mental imagery ability. A self-report inventory, Kids Imagery Scale (KIS), and objective performance task, Ski Run Assessment Tool (Ski Run), were designed and administered to measure these effects. In addition, qualitative data collection was obtained from logging procedures during the intervention phase and questionnaires in post-test. Results showed significant improvement from experimental group children on the Ski Run scores but not on KIS scores. Qualitative analysis showed some indication of improved imagery ability of experimental group children.

A secondary focus of the study examined the effects of the intervention on the mood and self-esteem of the children. The KISS Self-esteem Scale was designed and administered to measure change between groups and within groups. Though no significant improvement was realized, a significant correlation between self-esteem scores and KIS scores were found.

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Dedication

This paper is dedicated to my parents, Marilyn and Jack Howlett, who not only have guided me, supported me, and loved me unconditionally, but have always allowed me to imagine without judgement. I have been provided with a loving image to model, and exposed to an image of a wonderful world to live in.

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I. INTRODUCTION

Research over the past 10 years has shown that top athletes possess a number of superior mental skills (Carpinter & Cratty, 1983; Gould, Weiss & Weinberg, 1981; Hemery, 1986; Highlen & Bennet, 1979; McCaffrey & Orlick, 1989; Orlick & Partington, 1988; Rotella, Gansneder, Ojala & Billing, 1980). Along with other skills, athletes have been shown to have advanced abilities in mental imagery. In addition to possessing this ability, superior athletes claim to devote a great deal of time using and practising mental imagery (Orlick & Partington, 1988; Orlick & Lee-Gartner, 1993).

Research has not been limited to athletes only. Recent studies have examined the mental skills of other high performance professions including surgeons (McDonald & Orlick, 1992), classical musicians (Talbot-Honek, 1994), and architects (Sommer, 1980). All have found that elite performers in each of these fields have tremendous imagery ability.

A number of studies have shown mental imagery to enhance and improve performance achievement in both physical (Li-Wei, Qi-Wei, Orlick & Zitzelsberger, 1992) and mental tasks (Finke, 1989).

There have been claims that mental imagery is useful in stress reduction, goal setting (Orlick, 1992), improving self-esteem and enhancing positive self-images, phobia desensitization (Dyckman & Cowan, 1978), and healing (Ievleva & Orlick, 1991; Simonton, Mathews-Simonton & Creighton, 1978).

Considering the potential usefulness of this skill, should

educators not aim at improving mental imagery? Educators in the field of sport psychology have endeavoured to improve imagery in athletes and to devise plans to do so (Albinson & Bull, 1988; Orlick, 1986), yet surprisingly little research has been done on the effectiveness of such intervention programs. The available research on intervention programs is characterized by mixed results and questionable methodologies (Murphy & Jowdy, 1992). Perhaps more importantly, with exception of recent studies with figure skaters (Mumford, 1992; Rodgers, Hall & Buckolz, 1991) there has been little to demonstrate that imagery is a skill that can, in fact be developed.

The goal of this research was to examine the issue of mental imagery development. More specifically, it hoped to answer the question: can an imagery intervention program foster improved imagery ability among "normal" elementary school children?

The answer to such a question would have important implications for the field of sport psychology and education. Positive results would give support for the early development of mental skills in school and sport, by teachers, coaches, and mental training consultants who endeavour to facilitate improved mental skills for the children\athletes with whom they work. In addition, if imagery is an ability that can be nurtured successfully at an early age, then educational institutions should give serious consideration to its inclusion in school curriculums. Perhaps it can be directed towards improved learning and quality of life.

II. REVIEW OF LITERATURE

Definition of Mental Imagery

There has been numerous books and articles written on the subject of mental imagery. In view of the fact that this topic is extremely complex and subjective, the existing literature has created quite a divergent view of imagery, making it a rather confusing subject. In order to simplify the concept, a working definition is in order. Mental imagery is defined as "the mental invention or recreation of an experience that in at least some respects resembles the experience of actually perceiving an object or an event, either in conjunction with, or in the absence of, direct sensory stimulation" (Finke, 1989). This definition is consistent with other readily accepted definitions (Richardson, 1985; Murphy & Jowdy, 1992) and best defines the focus of this study. Murphy and Jowdy pointed out that the important elements of imagery are the "mimic" of sensory or perceptual experiences and the conscious awareness of the imagery process. Finke's definition effectively used "invention or recreation" to imply that the individual intentionally induces the imagery process. During both testing and intervention in this study, subjects were asked to induce their own imagery experiences.

Most people believe that they can form mental images. Nevertheless, it is problematic to prove that images can be differentiated from "ordinary" thoughts that might be considered as "self-talk". It is believed, however, that the brain does in

fact store information through these two distinct modes (Paivio, 1971). Images are a type of code for information storage which may exist in one or more sensory modalities (see Betts, 1909, for a description of the modalities). The brain also stores information through verbal codes, that is, actual words in a particular language. Together, images and verbal representations comprise what Paivio considered as the dual-code theory. Paivio's theory is a simple way of considering possible ways in which people may problem solve. Some may produce words in the mind as if talking to oneself, whilst others may formulate mental images. Piaget (Piaget & Inhelder, 1971) expressed the belief that children use a system of imaginal symbols in their thinking and learning which complement verbal symbolism.

Finke (1989) demonstrated some simple examples to illustrate that we do form mental images. For example he suggested that we consider the following questions: What colour is the stripe of the American flag? Did Thomas Jefferson have a beard? (Finke, 1989, p. 3) A more scientific method by Brooks showed that providing a visual stimulus can, in fact, interfere with mental imaging (Brooks, 1968). Subjects were asked to recall a block letter and verbally indicate in sequence, with a "yes" or a "no" whether each corner of the block letter was at the extreme top or extreme bottom. Subjects were then asked to do the same task however, the second time they were to indicate their answers by pointing to the word "yes" or the word "no". Brooks found that the visual stimulus of locating the words "yes" or "no",

interfered with the mental image of the block letter and therefore subjects were significantly slower in task performance the second time.

Application of Mental Imagery

The issue of mental imagery becomes particularly relevant when discussed in the context of its advantages and benefits to various fields that have been studied. Various fields in which mental imagery has been reported to be useful are discussed below.

Psychological therapy. Imagery has been used for a number of clinical purposes (Sheikh, 1983; 1986). It was believed that in conjunction with relaxation, images could be cathartic in nature (Frank, 1910, cited in Sheikh & Jordan, 1983). Guillery (1945, cited in Sheikh & Jordan, 1983) found a correlation between imagery and a number of physiological responses. With this in mind, a therapist could encourage a client to call upon imagery to resolve conflicts in order to produce psychophysical harmonization. Imagery has also been used in the exploration of the unconscious (Kosbab, 1974, from Shiekh & Jordan, 1983); as a creative process of the psyche employed to attain greater individual, interpersonal and spiritual integration (Jordan, 1979); in dealing with fears by having clients imagine how they would like to act in a situation where the fear exists (Wolpin, 1969); and for the purpose of diagnosis (Sheikh, 1983, ch. 13).

Healing. A number of studies have shown that mental imagery can induce several physiological responses such as salivation

(Barber, Chauncey, & Winer, 1964), changes in pupillary size (Simpson & Paivio, 1966), heart rate (May & Johnson, 1973), and increases in blood-glucose, inhibition of gastrointestinal activity, blister formation, and alterations in skin temperature (Barber, 1978). Given that physiological changes are possible through the use of imagery, a number of studies proceeded to examine if imagery could aid in producing positive rehabilitative results. Ievleva and Orlick (1991) demonstrated that a positive mental approach including mental imagery, fostered enhanced healing. Others have provided evidence supporting the use of imagery in the treatment of cancer (Fiore, 1983; Simonton, Mathews-Simonton & Creighton, 1978), and in the rehabilitation of illnesses and injuries such as ulcers, paraplegia, fractures, hip disarticulations, and intra-abdominal lesions (Korn, 1983).

The arts. Imagery in the arts is relevant for both the artist and the art audience. Fine arts, music, drama, and literature evoke sensory perceptual images (Lindauer, 1983). In addition, Child (1978) stated that the imagery in art has emotional and pleasurable consequences for those who experience it. Imagery has important consequences for the artist as well. Artists in various fields of art have reported extensive use of mental imagery in their work (Lindauer, 1983).

The use of mental imagery combined with actual practice, was shown to enhance the performance of college trombonists (Ross, 1985). Barr-Johnson (1982), in a quantitative assessment of children's artwork, showed that through visual stimulation and

visualization creativity could be enhanced. In a pre- post-test design, unbiased judges scored children's before and after artwork using quality of colour, texture, and design composition as criterion for scoring.

Sport. Sport psychology, though still in its emerging stages, is a world-wide phenomenon which is experiencing a great deal of enthusiasm and interest in the sporting world (Salmela, 1984). Much of the work in the applied field of sport psychology evolved around the use of mental imagery in preparation for performance.

A number of studies have shown that top athletes have highly developed imagery skills (Kreiner-Phillips & Orlick, 1993; McCaffrey & Orlick, 1989; Orlick & Partington, 1986; 1988). Hemery (1986) reported that 80% of a selected group of the world's top athletes use visualization in their preparation for performance. Another study of top Canadian Olympic athletes reported that 99% use imagery in their preparation (Orlick & Partington, 1988).

In order to enhance performance, an athlete will reconstruct past events through imagery in order to correct mistakes or the athlete will produce potential events as if practising and preparing for real life situations in sport (Suinn, 1983). There is evidence to support the claim that athletes who are highly skilled in their imagery (or perhaps have more control over their imagery) notice greater gains in performance after the mental practice of imagery (Clark, 1960; Start & Richardson, 1964)

Because imagery is considered a skill, many athletes practice their imagery in order to improve it (see Orlick, 1986). There is however, little direct evidence to show that imagery is a skill that can be improved.

Mumford (1992) reported that an intervention program of mental skills was somewhat successful in improving the imagery abilities of young female figure skaters. Yet there is little in the literature with regard to research that focuses solely on the skill of mental imagery. One such study (Rodgers, Hall & Buckolz, 1991) found significant improvement in visual imagery but not kinaesthetic imagery following an imagery training program. Though this evidence is encouraging, more research is needed in the area of imagery skill development, and the development of imagery in other sensory modalities.

Education. It has been argued that it is important to develop imagery early in childhood education (Lewis, 1984; Lovgren, 1977). Waas (1991) presented an extensive review of many of the beneficial effects researchers have observed through the use of mental imagery in education:

1. Children are more excited about learning.
2. Children are more secure and confident, with better self concepts.
3. Children are better and more skilful learners, with improved memory.
4. Children are more respectful of each other.
5. Children are able to maintain their own wellness,

including discontinuance of medications formerly taken.

6. Children are able to access discrete states of consciousness within which particular abilities reside, thus giving children skills in specific tasks.

7. Children are able to access their imaginations, creative processes, and intuitive capacities.

8. Children are able to develop expanded and higher order thinking skills and mastery of specific cognitive materials.

9. Children are aware of themselves through developed affective understanding.

10. Children are able to develop control over both internal and external communication, including behaviour.

11. Children are more expressive of their thoughts and feelings.

12. Children are more skilful in group interaction, including verbal feedback.

13. Children are more relaxed, and are thus more able to learn easily because there is less constriction of blood flow to the brain.

14. Children are better listeners because of guided imagery exercises.

15. Children are happier and more satisfied.

Though Waas sighted a number of references, many of these beneficial effects were supported by the research of Galyean (1982; 1983). Galyean (1982) pointed out that many of these effects are realized when imagery activities were integrated into

the curriculum: 1) as a preparatory to learning, and 2) within the lesson itself.

Lesgold, McCormick, and Golinkoff (1975) showed that the use of mental imagery facilitated prose comprehension. In a pre-post-test design the experimental group of grade three and four children were asked to read a story and illustrate the storyline with a sequence of sketches. The control group was simply asked a series of multiple choice questions regarding the content of stories previously read. Results showed that when instructed to use their imagery skills, experimental group children scored higher on the recall of stories.

Though imagery teaching has been shown to be beneficial, the education system is periodically blamed for not only failing to develop imagery skills but in fact to hinder its development (Greenson & Zigarmi, 1985; Lovgren, 1977; McKim, 1980). Perhaps imagery ability was lost because of what Lovgren calls "the persuasive onslaught of modern education methods" (p.268) or perhaps it is for other reasons. Nevertheless, I am reminded that children may avoid using this innate ability when I hear comments like that of my 6 year old nephew: "Imagining is for 5 year olds".

Though the literature has shown some evidence that imagery use has beneficial effects including facilitated learning, there is a void concerning the development of the skill itself. Research has only supported the use of imagery because of positive potentialities without giving thought to the skill

itself and the implications of improved imagery ability.

Mental Imagery and Human Excellence

Orlick (1992) proposed a model of the psychological factors necessary for achieving personal excellence based on the experiences of top performers. The seven basic elements of excellence include commitment, belief, focus, mental readiness, distraction control, constructive evaluation and positive images. According to Orlick, top performers effectively use mental imagery skills in such a way as "to create positive feelings about one's capacity, to pre-experience and re-experience positive actions, events, or performances, and to experience the feelings and sensations which accompany the successful execution of important procedures, skills or actions" (p.115). Orlick went on to credit top performers with having high quality images and provides references to support this claim.

It is important to note that not all top performers report making extensive use of imagery prior to achieving their status. One highly recognized surgeon noted: "When I first began, I was less into imagery. Of course then my contingency plan preparation was far less elaborate than it is now" (McDonald, 1992, p.40). What is of particular significance in the study of top performers is that many did not initially have good control over their imagery. In a qualitative study of top athletes, one highly successful Olympic diver reported: "It took me a long time to control my images and perfect my imagery, maybe a year, doing it every day" (Orlick & Partington, 1988, p.174).

The study of expert performers can provide some important models for educational purposes--and imagery, being an important component, should be given consideration when designing educational programs. Though the literature is lacking in regard to the extent to which children use imagery to perform tasks, there has recently been research by Li-Wei, Qi-Wei, Orlick & Zitzelberger (1992) that indicated that children may benefit from imagery training. This study demonstrated positive performance effects in table tennis for children 7-10 years old as a result of imagery training. What remains to be investigated is the extent to which "normal" children can develop and improve their imagery skills. Considering the potential benefits that children can experience from the use of mental imagery, it would be worthwhile to examine the prospects for teaching this skill, including an evaluation of an imagery intervention program.

Research on Mental Imagery

Based on the review of the literature, important implications for future imagery research lie in both the development of imagery as a skill and imagery with children. Though there has been much written on imagery, it remains as an extremely challenging subject to investigate. Therefore, in this section, some issues related to imagery research are briefly discussed.

To determine the extent of development of any skill, one needs a reliable and valid instrument to measure the skill. Ideally, that instrument should be used before and after an

intervention program aimed at improving the skill. Negative results might only indicate that the instrument was not sensitive enough to assess change or that the intervention was poorly designed or poorly executed. Positive results would, however, indicate that the skill is one that is capable of development, assuming that the instrument was clear and understandable. Skilled imagery is often referred to as including vividness, completeness and control (Murphy & Jowdy, 1992; Orlick, 1986). Measuring imagery vividness is an extremely challenging task. Ahsen (1985) explains about the difficulties associated with this field of study:

Imagery, by its nature, is a subjective, private phenomenon, complex in its aspects, and, more often than not, in a state of rather fluid change. This clearly creates difficulties for the scientific study of imagery, given the need within science for a precise, objectively verifiable characterization of the phenomenon under scrutiny. (p.89)

Due to imagery's internal subjective nature, there is no way to directly assess or quantify it (Reisberg & Heuer, 1988). The strengths and weaknesses of various methods of measurement are discussed succinctly by Sommer (1980):

Personal interviewing rates high in understanding and elaboration of responses, but poorly in objectivity, control, and economy...Self-report may still be useful in clinical practice or in idiographic studies, but its

utility in research is limited by its low correlation with behaviour. Performance tests in such areas as educational and industrial psychology do correlate with behaviour. However, their predictive value is better for groups than for individuals. (p.118)

A number of subjective tests include self-report questionnaires such as the Gordon Test of Imagery Control (Gordon, 1949) which subjects responded affirmatively or negatively about their ability to manipulate evoked images, and the VVIQ (Marks, 1973), which asked subjects to rate the vividness of the visual imagery according to 4 aspects of 4 familiar scenes. Marks (1973), in a study on memory performance, claimed to have found a relationship between memory tasks and self-report vividness measures. Based on these results, Marks concluded that images have an important role in memory. Nevertheless, caution should be exercised in considering these findings. When evaluating performance measures we should consider whether the task demands imagery skills or is simply aided by it (Reisberg & Heuer, 1988). In Marks' experiments, those who scored high in memory tasks may have used a more complex system of coding not involving mental images. There is no way of reliably knowing whether subjects were using images or not. Therefore, despite Mark's results that showed a relationship between self-report imagery ability and memory, it should not be assumed that high performance of memory tasks is an indication of that subjects were utilizing superior imagery ability.

In mental imagery research with children, the use of memory tasks to develop imagery skills creates practical problems. For example, in pilot work for this study, it was observed that memory tasks were perceived to be similar to academic tests which created a certain amount of anxiety in children. This was seen through obvious signs of stress including sighs of anxiety, pouting and even cheating. This perception of evaluation would be difficult to control in memory tasks, therefore it would be best, perhaps, to avoid memory tasks in imagery research.

Objective tests involved the spatial manipulation of stimulus objects such as the Space Relations Test (Bennet, Seashore & Wesman, 1947). Hall, Pongrac, & Buckolz (1985) discussed the objective tests as involving the presentation of a three-dimensional object, which subjects are asked to imaginably manipulate (e.g. rotate the object) . Then subjects are asked to choose from a set of alternatives the appropriate object that they feel appears to be the stimulus object in the manipulated position.

In addition to spatial tests, performance tasks have been utilized as an objective measure of imagery ability (Riding & Taylor, 1976; Simpson, Vaught, & Ham, 1971). Performance tasks have, however, suffered from a lack of certainty as to whether imagery was actually being utilized in the performance of the task. Though objective tests might be preferable, because of their unbiased nature, it remains difficult to find a truly valid performance test which clearly measures imagery ability.

The issue of validity, might lend support to subjective measures because they appear to be more directly linked to imagery than do objective measures (Katz, 1983). If the right questions are asked and if it is possible to secure honest answers from participants, then self-report can make a significant contribution. For many years, the Betts' Questionnaire Upon Mental Imagery (QMI) has been the most comprehensive test of imagery ability (Sheehan, 1967). The QMI measures imagery ability in seven sensory modalities: visual, auditory, cutaneous, kinaesthetic, gustatory, olfactory, and organic (Betts, 1909). Due to the prohibitive length of the QMI, a shortened version has since come forward and has shown to produce similar results as the QMI (Sheehan, 1967). Sheehan's Shortened Version of the Betts' QMI remains as one of the more widely used and reliable measures of imagery ability (Ernest, 1977; White, Sheehan, & Ashton, 1977). Sommer (1980) argued that a more fruitful strategy in assessing imagery ability would be to combine self-report with other measures. It would be prudent to explore new objective measures, such as a valid performance task, to be used in conjunction with a self-report such as Sheehan's Shortened Version of the QMI.

Self-report tests have been administered with some degree of success, yet these self-report questionnaires have been designed and validated with adults in mind. All available questionnaires such as the QMI have been in written format and in language designed for adult comprehension. No validated measures have been

designed in order to be well understood by children.

III. METHODOLOGY

The Kids Stress Study (KISS) was initiated at a number of primary schools in the Ottawa Board of Education in January, 1993. KISS was designed in response to a growing need to equip children with appropriate skills to assist them in dealing with the ever-increasing stress associated with the school, home and social environments. The aim of the KISS Project was a broad one, designed to build life skills such as: positive thinking, focusing, refocussing, relaxation, and creative imagery (see Orlick, 1993). This research contained the "imagery" component of the Kids Stress Study.

Many of the components of KISS were aimed specifically at reducing stress or building self-esteem. This one differed from the others in that it specifically aimed at improving the skill of mental imagery. It was hoped that by improving this skill, which is often neglected in school curriculums (Galyean, 1983), children would be better equipped to deal with stress, and gain many of the benefits associated with mental imagery. This study did take an inventory of the feelings and mood of the children involved to examine the effects of the imagery intervention. However, it was felt that it would have been premature to have made stress reduction and self-esteem building the primary aim of the intervention, because of the dearth of knowledge about imagery ability.

This research sought out to obtain data related to imagery ability and the development of imagery in children. An imagery intervention program was implemented with the goal of improving mental imagery ability. Pre-test and post-test measures were administered in order to evaluate and compare imagery ability prior to and following the independent variable (imagery intervention program).

Subjects

The research conducted focused on primary school children in grades 1 (two separate grade 1 classes), 3, 4, 5, and 6 (approximately 6-11 years old) at Vincent Massey Public School, Ottawa. Vincent Massey is located in a suburban area of Ottawa East, and is made up of students with a variety of backgrounds including a high immigrant population of children from East Africa, Middle Eastern countries, and Far East countries like Somalia, Lebanon, and Cambodia respectively.

The subjects were from six classrooms. Each class was divided, by random assignment, into two equal groups: experimental (E) and control (C). Within each grade, both E and C were equal in terms of teacher bias and gender breakdown.

Prior to research, the parents of all children were sent a brief description of the research to be conducted and a permission form to be returned. A small number of forms (approximately 6) were unreturned and an equal number were returned with parents wishing to exclude their children from the study. The reasons for exclusion were generally not given except

in two cases where parents of one child believed that research was inappropriate in the school setting, and another child's parents believed that the nature of this research was contrary to Fundamentalist Christian Doctrine. All these children were excluded from the study.

Method

Instruments. The methodology included a triangulation of the data from three sources: 1. Self-report Inventory (designed for children); 2. Overt Performance Task (requiring imagery); and 3. Qualitative reporting (during intervention) and questionnaires (post program).

A self-report inventory, called the "Kids Imagery Scale" Inventory or KIS Inventory (Appendices I,II,III, IV) was developed to assess imagery following the basic model of the Children's Skimetric Differential (Orlick, Partington, Scott & Glassford, 1975). It was primarily pictorial in nature, with brief accompanying written descriptors in language comprehensible to children, and contained similar modalities to adult assessment tools such as the Bett's QMI. The experimenter presented, explained, and guided subjects through the inventory with verbal instructions, using descriptors derived from children during pilot research.

A quantifiable performance task designed for this study was administered. The task is called the "Ski Run" Assessment Tool (Appendices V, VI). The subjects were asked to engage in the following steps: 1) visually attend to a patterned

representation of a path ("ski run"), 2) image the path while closing their eyes, 3) image themselves tracing the path while actually moving their finger over the path, and 4) trace the path with pen or pencil while blind-folded. The path was divided into 10 sections used to empirically score the Subject's performance on this task. If the Subject's drawing remained completely on the path within a particular section they scored 1 point. For each section where the subject was partially on the path they would score 0.5 points. If they failed to touch the path in a particular section they scored 0 points. Each section's score was added to give a total performance score out of a possible 10 points. A floating transparent scoring device was used, in order to credit a drawn pattern which closely replicates the desired pattern and yet fails to fall on the path.

A secondary focus of this research looked at the effects of the intervention and imagery on children's self-esteem. A pictorial self-esteem questionnaire (Appendix VII), designed for the KISS program and validated by Donohue (1993), was used to assess change and to measure the relationship of self-esteem and imagery measures. It is important to note that improvement in self-esteem was not the aim of this research but rather a secondary focus because of the ease to which this could provide interesting information.

Qualitative data collection similar to those used by Mumford (1992), were conducted during post-test phase, with experimental group subjects in an attempt to gain more in-depth information

about their imagery experiences.

Qualitative reporting was included in order to provide relevant information and analysis of E children's progress during the intervention component of this research. This progress was monitored and recorded in a logbook during and immediately after each intervention session whenever possible.

Intervention. A selected number of games and activities (see Orlick, 1993, for examples of activities) were taught to children during 15 min. segments during regular school days. The intervention occurred usually 3 days per week for 9 weeks. Activities were designed and planned in advance with allowances, in the latter stages, for modifications and new ideas (see Appendix VIII for description of intervention program).

Procedure

Pre-test. The KIS Inventory and Ski Run Assessment Tool was administered over three days. Administration of these tests included all subjects, as experimental (E) and control (C) groups were not determined at the point of pre-test.

Intervention. Once subjects were assigned to E or C, E was exposed to the intervention of imagery games and activities (independent variable).

Post-test. The instruments used during pre-test were re-administered to children from E and C simultaneously over a three day period. Qualitative questionnaires were administered to E children during this phase in order to gain more in depth information.

Data Analysis

Pre- and post-test measures provided quantitative data of imagery ability of E and C children. Simple change scores, as suggested by Zumbo, Williams and Zimmerman (1993), allowed for T-tests to be conducted in order to make appropriate comparisons and assessment of intervention effectiveness. In addition, Pearson product moment correlation of the KIS Inventory scores and the Ski Run Assessment Tool were calculated to determine the relationship between the subjects' self-report on their imagery ability and imagery ability based on performance.

Finally, relevant interview and questionnaire data were collected during intervention and post-test and were qualitatively analyzed following the procedure utilized by Mumford (1993), and Orlick and Partington (1982).

IV. RESULTS

Quantitative Analysis

Kids Imagery Scales (KIS). The KIS was a self-report inventory aimed at assessing children's imagery ability in seven sensory modalities as does the shortened version of the Bett's Questionnaire Upon Mental Imagery (Sheehan, 1967). KIS, with the aid of the test administrator, asked children to imagine seeing a butterfly (hearing a bell ringing, feeling snow, tasting a lollipop in their favourite flavour, etc). Children then rated the quality/clarity of their imagery on a 5-point scale (modality subscale), which was illustrated pictorially. For example, on the

visual scale, 1 would equal "In my mind, I can't see (hear, feel, taste) anything", and 5 would equal "In my mind I can see (hear, feel, taste) it like it's real".

In addition to the seven sensory modalities, other subscales were added including: imagining feeling relaxed, imagining feeling strong and confident, imagining seeing oneself helping others, and imagining feeling oneself helping others. The kinaesthetic modality was also divided into 2 subscales, differentiating between imagining feeling a body part move (e.g. toes) and imagining feeling the whole body moving through space (e.g. running). In total, KIS consisted of 12 subscales, which allowed for an assessment of change for individual subscales and combined scores of all the subscales out of a possible 60.

Results from KIS showed that the experimental group reported higher means scores on 10 of 12 modalities (subscales) and a higher overall mean KIS score while the control group reported higher means on only 7 of 12 modalities but did report a higher overall mean KIS score. However, the within group improvement reached statistical significance only for the experimental group in the "Organic" modality (feeling confident and strong), $t(56)=2.283, p<.05$ (Table 1).

Since this study used experimental and control groups, it allowed for between group comparison of this change. Utilization of change scores, as recommended by Zumbo, Williams, and Zimmerman (1993), was a useful tool to compare this change. The experimental group showed a higher mean change on 8 of the 12

Table 1

Within Group Comparison of Mean Scores of KIS Inventory and Modality Subscales

Modality	<u>Control</u>		<u>Experimental</u>	
	Pre	Post	Pre	Post
Visual	4.20 (n=50)	3.90	3.27 (n=57)	3.58
Auditory	3.98 (n=50)	3.96	3.59 (n=57)	3.96
Olfactory	3.96 (n=50)	3.28*	2.98 (n=57)	3.26
Gustatory	4.00 (n=50)	3.76	3.49 (n=57)	3.79
Feeling body parts	4.18 (n=50)	3.98	3.67 (n=57)	3.77
Cutaneous	4.24 (n=50)	3.86	3.67 (n=57)	3.75
Organic	4.45 (n=53)	4.53	3.98 (n=57)	4.39**
Movement	4.42 (n=53)	4.36	4.02 (n=57)	4.11
Relaxed	4.34 (n=53)	4.40	4.40 (n=57)	4.10
Feeling happy	4.20 (n=56)	4.23	4.04 (n=57)	4.02
Helping others (visual)	4.11 (n=56)	4.16	4.18 (n=57)	3.93
Helping others (kinaesthetic)	4.14 (n=56)	4.20	3.91 (n=57)	3.93
Total of KIS	50.33 (n=49)	48.25	45.26 (n=57)	46.47

*significant, $t=2.560$, $p<.05$

**significant, $t=2.283$, $p<.05$

modality subscales. However, independent T-tests of this change reached statistical significance on only two modalities:

"Visual", $t(106)=2.344, p<.025$; and "Olfactory" (smell), $t(106)=2.657, p<.01$ (Table 2).

A break down of KIS scores by grade showed that in 5 of 6 grades (grade 3 being the exception) the experimental groups had higher means of change scores than did the control groups. Comparisons between control and experimental groups by grade did, however, fail to reach significance in all cases (Table 3).

One grade one class, and the grade four class control groups were statistical higher on self-reported imagery in pre-test than the corresponding experimental group by grade, $t(15)=2.425, p<.05$ and $t(18)=3.703, p<.01$, respectively. In post-test, there were no differences between groups by grade. This might suggest that the intervention had an effect on the grade one and four class in that they became more similar at post-test, however these results are tainted by the two factors. First, these two groups were not equivalent in the beginning therefore allowing for limited experimental control of outside variables. Secondly, the control groups scores were very high in pre-test, therefore leaving little room for improvement.

Ski Run Assessment Tool. Objective tests often come under scrutiny because there is a question as to whether the task involved in the test clearly relies on imagery to be performed (Hall, Pongrac & Buckolz, 1985). The Ski Run Assessment Tool (Ski Run) sought to provide an empirical measure based on a task that

Table 2

Between Groups Comparison of Mean Change Scores of KIS Inventory
and KIS Modality Subscales

Modality	Control	Experimental
Visual	-0.30 (n=50)	0.31* (n=57)
Auditory	-0.02 (n=50)	0.36 (n=57)
Olfactory	-0.68 (n=50)	0.28** (n=57)
Gustatory	-0.24 (n=50)	0.30 (n=57)
Feeling body parts	-0.20 (n=50)	0.11 (n=57)
Cutaneous	-0.38 (n=50)	0.09 (n=57)
Organic	0.08 (n=53)	0.40 (n=57)
Movement	-0.06 (n=53)	0.09 (n=57)
Relaxed	0.06 (n=53)	-0.30 (n=57)
Feeling happy	0.04 (n=56)	-0.02 (n=57)
Helping others (visual)	0.05 (n=56)	-0.25 (n=57)
Helping others (kinaesthetic)	0.05 (n=56)	0.02 (n=57)
Total of KIS	-2.08 (n=49)	1.21 (n=57)

*significant, $p < .025$

**significant, $p < .01$

Table 3

Between Group Comparison of KIS Inventory Mean Scores and Mean Change Scores by Grade

<u>Grade</u>	<u>Control</u>				<u>Experimental</u>			
	<u>Pre</u>	<u>Post</u>	<u>Change</u>	<u>n</u>	<u>Pre</u>	<u>Post</u>	<u>Change</u>	<u>n</u>
1a	56.0	52.75	-3.25	(n=8)	44.67	45.67	1.00	(n=6)
1b	53.75*	53.38	-0.38	(n=8)	42.78	51.0	8.22	(n=9)
3	44.0	41.11	-2.89	(n=9)	47.78	43.78	-4.0	(n=9)
4	53.22**	47.33	-5.89	(n=9)	46.25	45.25	-1.0	(n=11)
5	46.67	47.83	1.16	(n=6)	45.25	48.75	3.5	(n=8)
6	48.11	48.0	-0.11	(n=9)	44.71	45.28	0.57	(n=14)

* significant difference from experimental group in pre-test,
p<.05

** significant difference from experimental group in pre-test,
p<.01

must rely on imagery to be performed well. Subjects were instructed to image the curvature of the path and then to run their finger over the path. They were then instructed to do this blind-folded. The ultimate task of tracing the path was executed blind-folded based on recall of the path and previous movement over the path. Blind-folding subjects insured that efficacy would be dependent on the individual's use of imagery.

Following the pre-test phase, experimental and control groups showed no difference in mean scores, $t(111)=0.54$, $p<.05$. Following intervention, independent t-test of change scores showed the experimental group to be significantly different than control, $t(110)=2.75$, $p<.025$ (Table 4). Potentially, a comparison of change scores might show significance even if the best group had not improved or if both groups had regressed. Results would simply show that one group had not regressed as much. This might, however, still suggest a positive cause-effect relationship with the independent variable and this is conceivable when considering mental imagery ability. According to one school of thought, imagery ability may decline with age because of social pressure or present teaching methods (McKim, 1980). Hence an intervention program might effectively serve to maintain inherent imagery ability. Therefore a two group comparison with a pre-post design is the most appropriate to explain a possible loss of imagery ability. In the present study, however, not only did the experimental group differ from the control in post-test but the intervention group experienced significant improvement of Ski Run

Table 4

Comparison of Experimental Group (E) and Control Group (C) Ski
Run Assessment Tool (Ski Run) Mean Scores [out of 10]

Group	Pre-test	Post-test	Change
C	5.48 (n=54)	5.20 (n=64)	-0.17 (n=53)
E	5.28 (n=59)	6.39 (n=59)*	1.10 (n=59)
	no difference	significant p<.001	significant p<.01

*significant improvement from pre-test, P<.001

scores following imagery training, $t(58)=3.688$, $p<.001$ (Table 4).

Analysis by grade breakdown showed that 5 of the 6 intervention groups showed higher mean change scores than the control group. Significant difference was found for the grade three between group comparison, $t(19)=2.727$, $p<.025$ (Table 5). One grade one class scored significantly higher in post-test than the control group, $t(9)=2.280$, $p<.05$, as did the grade six class, $t(22)=2.079$, $p<.05$ (Table 5). Both these grades failed to reach significance on change scores however.

KIS versus Ski Run. Both KIS and Ski Run sought to measure imagery ability. It was felt that combining a performance task and a self-report test would best explain and validate the effects of an imagery intervention. As the KIS and Ski Run Assessment Tool showed different results regarding imagery improvement in experimental group children, it is not surprising that insignificant correlation was found between these two measures. This failure to find a relationship between different types of imagery measures is consistent with the existing literature (see Hall, Pongrac & Buckolz, 1985; Ernest, 1977; Richardson, 1977).

Three sensory modalities of KIS, that would be most related to those used in Ski Run (visual, body part movement, and movement through space), were isolated to test their relationship with Ski Run. All three failed to show any significant relationship. Comparison of change in KIS and change in Ski Run also failed to show a significant relationship.

Table 5

Between Groups Comparison of Mean Ski Run Scores and Mean Change Scores by Grade

<u>Grade</u>	<u>Control</u>				<u>Experimental</u>			
	<u>Pre</u>	<u>Post</u>	<u>Change</u>	<u>n</u>	<u>Pre</u>	<u>Post</u>	<u>Change</u>	<u>n</u>
1a	6.4	4.9	-1.5	5	5.8	7.3 ¹	1.5	6
1b	4.9	5.5	0.6	9	6.4	5.4	-1.0	9
3	4.6	4.7	0.1	11	3.4	5.8	2.4*	10
4	5.9	5.1	-0.8	8	5.4	6.7	1.3	11
5	6.2	5.0	-1.2	10	5.5	5.3	-0.2	9
6	5.4	6.4	1.0	10	5.4	7.5 ²	2.1	14

* significant improvement versus control group, $p < .025$

¹ significantly different from control group in post-test, $p < .05$

² significantly different from control group in post-test, $p < .05$

Imagery and its effect on self-esteem. During pre- and post-test, a self-esteem scale, similar to that used by Donohue (1993), was administered. Donohue found that the scale significantly correlated with the widely used Culture-free Self-esteem Inventory for Children and Adults (Battle, 1981). Though self-esteem was not the focus of this study, it was felt that surveying subjects' feelings about themselves might provide some interesting information about the effects of mental imagery. It is important to note that this was not the aim of this research, nevertheless this study provided an excellent opportunity to examine this issue with relative ease and with no cost to the primary purpose.

The KISS Self-esteem Scale gives an overall score out of 15 by measuring three 5-point pictorial sub-scales: 1. stressed/relaxed, 2. happy/unhappy, and 3. feeling good/bad about oneself.

Results revealed that experimental group children reported higher means on each of the sub-scales and on the mean overall rating on the KISS Self-esteem Scale in post-test than their reported ratings in pre-test, though statistical analysis revealed non-significance in all cases. The control group children showed lower mean self-ratings on each of these scales in post-test than they had rated themselves in pre-test, however this decline in self-esteem scores was also non-significant (Table 6). Analysis of the between group comparison showed the control group to be significantly higher in self-esteem than the experimental group in pre-test, $t=3.197$, $p<.01$, and yet faltered

Table 6

Within Group and Between Group Comparison of Mean Scores and Mean Change Scores on KISS Self-esteem Scale (SE) and Subscales

<u>Scale</u>	<u>Control (n=60)</u>			<u>Experimental (n=59)</u>		
	<u>Pre</u>	<u>Post</u>	<u>Change</u>	<u>Pre</u>	<u>Post</u>	<u>Change</u>
Stressed/ Relaxed	4.15 ¹	3.82*	-0.33	3.59	3.78	0.19
Happy/ Unhappy	4.08 ²	3.98	-0.10	3.58	3.88	0.30
Feeling Good/ Bad About Oneself	4.18 ³	4.06	-0.12	3.71	3.76	0.05
Total of SE Scale	12.42 ⁴	11.87	-0.55	10.88	11.42	0.54

¹ significantly higher than experimental group, $t=2.975, p<.01$

² significantly higher than experimental group, $t=2.839, p<.01$

³ significantly higher than experimental group, $t=2.467, p<.05$

⁴ significantly higher than experimental group, $t=3.197, p<.01$

* significant decline from pretest, $t=2.098, p,.05$

in post-test in that there were no longer significant differences between the two groups. Comparison of change scores showed that there were no significant differences between the two groups. Given that the two groups moved from being dissimilar to similar from pre- to post-test, it is possible that the intervention may have had some effect on self-esteem. This interpretation is, nevertheless, far from conclusive and must be understood as merely a possibility. However, these results might have implications for an imagery intervention designed specifically to enhance self-esteem and might warrant further research in this area.

KIS and Ski Run versus Self-esteem. Perhaps the most relevant finding from the KISS Self-esteem Scale is its relationship to the imagery measures of this study. Pearson product moment correlations were conducted with these measures. Self-esteem scores and KIS scores correlated in pre-test, $r=.324$, $p>.01$ ($n=108$), and in post-test, $r=.459$, $p>.01$ ($n=120$). No relationship was found between Self-esteem scores and Ski Run.

The decision to perform this analysis came from a casual glance at individual test results and observing a tendency for subjects, even intervention subjects, to rate themselves poorly on imagery at the same time as rating their mood/self-esteem to be low. Reflection on this analysis would suggest that there is connection between mood and ability to image effectively or least between mood and self-rating.

Qualitative Analysis

Anecdotal Evidence

The intervention program provided an excellent opportunity to gain information about subjects' imagery experiences and feedback about their progress. Regular logging of information during and immediately after intervention periods, allowed the researcher to extract pertinent information for data analysis. It is important to note that subjects were not prompted in any way to discuss imagery ability or to believe that the researcher had any expectations or desires about the results. This allowed children to speak freely about their imagery experiences or lack of imagery without any value placed on their responses.

In order to foster improved imagery ability, the intervention was divided into four stages: 1. awareness of imagery, 2. inducing imagery, including the various sensory modalities, 3. controlling imagery (quality of imagery), and 4. utilizing imagery skills. Results will be discussed in these four areas.

Awareness of imagery. Early intervention began with activities aimed at creating awareness of the mind's images and attending to those images. For example, the children were asked to view both static and moving video images and then asked to close their eyes and recall those images. Discussion followed relating to the nature and extent of their images. Approximately 1 child of every 8 reported to have no images at all:

"I couldn't see anything, just black." (grade one boy)

"I saw black with white squares." (grade one girl)

A number of children claimed to see exactly what was on the television screen, but many more reported to have partial or inaccurate images of the video image:

"I could sort of see one of the cows" (grade one boy)

"I saw a black cow with a tail..." (grade three boy, there were 2 cows and no tail could be seen)

"I saw the baby zebra, but instead of feeding from the mother but I saw it walk right through its mother's legs."
(grade 4 girl)

"I saw the zebras but they had funny coloured stripes."
(grade 5 girl),

Others reported to have images completely different from the video images:

"I saw the Flintstones and Little Foot." (grade one boy)

"I kept seeing green monsters." (grade one boy)

These children were asked if they wanted to have these images or if they "just popped in their heads". Most often, they responded that the images occurred spontaneously without intention. It may be important to note that video images were only used as a stimulus and focus for creating mental images. This exercise was simply used to encourage children to be aware of any mental images they might have.

On the second day of intervention children were asked to sequentially verbalize the small or long letters (i.e. "a,c,e,i,..." or "b,d,f,g") of the alphabet without any visual presentation of the alphabet (see McKim, 1980). Such a task should rely on a mental scan of the alphabet to imaginably locate the appropriate letters. Every single child, from grade 1-6, had an opportunity to attempt this task and every child was ultimately successful. Only 3 children of the entire experimental group had slight difficulties in their initial attempt. It was noted that these three children displayed similar behaviour during their first attempt: they were looking directly at their peers and were laughing and giggling. Undoubtedly distractions or self-consciousness allowed them to lose focus and fail to attend to any mental images. Consequently these children were asked to make a second attempt but from behind a divider which prevented them seeing their classmates. All three children performed the task successfully on the second attempt. Most of the children who were immediately successful were seen to stare upwards or even to close their eyes while performing the task.

Following the completion of this task, the children were asked "Which letters do you prefer to call out, the small ones or the tall ones?" Overwhelmingly the children preferred the tall letters. When asked why they preferred the tall letters, they typically responded with "the tall letters stick out", which suggests an easy way to visually identify them, and "because you can see them". This provided an excellent opportunity to point out to the children that somehow they were able to "see" the letters without an actual retinal image.

During early intervention, children were also asked to imaginably scan a block letter to sequentially verbalize the corners of the letter that were to the extreme top or bottom (Brooks, 1968). All the children were able to perform this task successfully. One grade one boy claimed that he could not imaginably see the letter, yet he performed this task with his eyes closed. This may be an indicator of some sort of imaginal process without any awareness of it.

During the fourth intervention, a video image of movement over of an oceanic landscape was used to as a prompt for kinaesthetic imagery. Subjects were asked to view the video and then to imagine themselves flying over the ocean, trying to be aware of both "seeing" and "feeling". Grades 4, 5, and 6 were then asked to indicate in writing on a small piece of paper the extent to which they could imaginably "see" and "feel" the movement:

Could you see (feel) yourself flying over the ocean "like

real", "a little", or "not at all"?

They were then asked to describe their image. Of 31 children, 20 reported to visually image like real:

"I saw me dancing over the water." (grade 4 boy)

"I saw water. The sun was about to go down. The water was orange. I saw a mountain and the sky" (grade 5 boy)

"I saw the water and the sun was setting. I also saw two trees and the wind was blowing the trees." (grade 5 boy)

"I saw the sunrise over the water and with the colours of fire and navy blue for the water and just a bit of blue in the top corners" (grade 6 boy)

"I saw a sunset and an ocean and I was in a boat trying to catch the sun...It was a beautiful scene." (grade 6 girl)

Nine children reported to visually image only a little:

"I could see what was on the T.V. but it was a bit blurry."
(grade 4 girl)

"To me it was pitch black but then I could kind of see a tiny tugboat going by ringing a bell." (grade 6 girl)

Two of the children (grade 4-6) reported that they could not see any mental image. Fourteen of the 31 children reported to imaginably "feel" like real:

"I was in a helicopter and I was flying over the water and it was splashing on me" (grade 4 girl)

"I felt like I was on the fastest boat in the world, riding in it, and getting lots of air and feeling good about me."
(grade 6 boy)

"I felt like I was a bird flying into the sunrise." (grade 6 boy)

"I saw a sunset and water flowing and it made me feel nice and warm. I felt the nice cold water when I was hanging my hand over the boat in the water." (grade 6 girl)

Twelve of the children reported feeling "a little", while 4 reported no feeling image at all. One child omitted to respond regarding feeling imagery. Interestingly, a number of children reported more global feelings such as relaxed, happy, excited, or free:

"I felt like I was really there and it was very relaxing and exciting." (grade 6 girl)

"I felt relaxed and happy." (grade 5 boy)

"I felt like I was moving fast and feeling good about me."
(grade 6 boy)

"I felt free and I put all my troubles behind me. I also
liked it a lot." (grade 6 girl)

Without prompting, some children also reported experiencing
images in other sensory modalities (e.g. auditory, olfactory,
kinaesthetic):

"I was a bird flying over the sea. I could hear other birds
chirping." (grade 4 girl)

"It was like I was superwoman and I was flying over the
lake. I could hear birds singing my favourite song." (grade
5 girl)

"I could smell salty water and I was going over it fast...
very fast." (grade 6 girl)

"I felt like I was there and I could hear and feel
everything about it." (grade 6 girl)

Inducing imagery. The second stage of imagery development

centred on provoking mental imagery by various stimuli such as audio-tapes (Orlick,1993b), or task performance. Task performance stimulus included activities such as "Object Drawing". In this intervention, children were blindfolded, and asked to feel various inanimate objects in order to promote an image of the objects without actually seeing them. Initially, objects were somewhat recognizable, such as a giraffe carving or a pineapple. With recognizable objects there was no way of knowing whether children were using mental images in order to draw pictures of these objects or whether they relied on the memory of what such an object may look like. Since the connection between memory and mental imagery is still unclear, there is no guarantee that imagery was being utilized. An examination of the children's drawings showed that virtually all contained certain characteristics that could not have been discovered by feel, such as the spots on a giraffe. In addition, certain characteristics that should be obvious by feel were omitted, such as a chip of the carving that was missing or a large protrusion in the carving.

When unrecognizable objects were used, such as an abstract carving or an odd shaped piece of glass, the children were, in essence, forced to pay attention to important characteristics of the object. Although initially difficult, because of wanting to know what the object was, children soon found that they could conjure up images of the object without knowing what the object was:

Child: "I can't tell what it is."

Researcher: "Don't worry about what it is. What does it feel like...ask yourself what am I feeling now?"

C: "Well it's flat on the bottom and smooth. On the top it's kind of smooth like a cut-off tree."

R: "Good."

C: "On the side it's rough and there are long thin things"

R: "Okay, try to picture these shapes in your mind. Now go draw it the best you can."

At some point between feeling the unrecognizable object and drawing there must be an attempt to imagine it's characteristics or the task of drawing would be extremely difficult because there would be no prior knowledge of such an object. An examination of these drawings showed fairly good accuracy and detail of at least part of the object in question, whereas drawings of recognizable objects lacked unique contouring detail.

It was hoped that by creating activities that depended on imagery, children would improve their imagery ability by simply using it when normally they may not.

During the third week of intervention, Sound Listening (Orlick, 1993) audio tape segment was used to induce mental images. Sound Listening is a recording of various sounds and noises such as "a dog barking" or "brushing teeth". The children were encouraged to see, feel and hear the various sounds in their minds during and following the audio stimuli. Most of the

children were able to create visual images from the sound stimuli. However, children who initially reported having weak imagery skills also claimed to have no images or weak images in response to this exercise.

When Sound Listening II was played children were requested to hear and feel the images of the sounds on the audio tape and to try to "not see" visual representations of the sound. Such paradoxical intention (Frankl, 1986) was attempted to counteract the possibility that some children may have hyper-intended visual images. Hyper-intention of visual images could conceivably have raised the expectations of those images so much that the experience could have become frustrating. This strategy showed to be somewhat successful. A number of children reported to see better when they tried not to see. This occurred despite the fact that children should have perceived that the researcher wanted them to "not see" any images. One grade four boy said, "When I tried to see, it went away and when I tried not to see it came back". A grade five girl reported, "When I tried not to see, I sort of saw--it flashed...I saw it and it went away and then it came back". One grade three boy reported to have no mental images but was able to imagine better than previous interventions:

Researcher: "What was in your mind when you listened to the
tape?"

Boy: "I imagined my cat in the kitchen."

R: "Could you see it?"

B: "No."

R: "How do you know you imagined it?"

B: "It's like thunder. When it thunders, I can feel it. It's the same as that."

Overall very few children reported being able to avoid seeing images when asked to "not see" (approximately 1 in 5 children). There were more children who claimed to actually see better when asked to "not see".

Heart rate monitors aided in proving to the researcher and the children that they could create images that were accompanied by physiological responses within their bodies. During one intervention in this stage, children were asked to remain still and to call up both relaxing images and more activating images. The heart rates of 30 children in the experimental group were recorded in the logbook. Of these children, 14 were shown to increase their heart rate from the baseline measure when inducing activating imagery and subsequently to reduce their heart rate back to the baseline measure during relaxing imagery. The other 16 children were shown to increase their heart rate during activating imagery and then to reduce their heart rate below the baseline measure during relaxing imagery. Relaxing imagery included experiences such as: "lying on a beach," "lying in bed," "thinking of my Mom," and "lying on a hammock with the sun shining. "Activating imagery was more diverse with experiences such as: "my mom bought me a toy store," "imagining a boy I

like," "my brother cheating when playing marbles," "being in a race," "doing Tai Kwan Do," "a dog chasing me," "a robber in my house, and "doing a poem in front of the class."

The children were intrigued at the effects that imagery could have on their heart rate. When asked why they think they were able to do this some children responded:

"Your brain sends a message to your ear [heart monitors were attached to the earlobe] and to your heart." (grade 5 boy)

"Oh your mind's attached to your heart." (grade 3 boy)

"Because your body listens to your mind." (grade 4 girl)

"Because when you imagine it, your mind is thinking 'Oh my God, I'm going to have to do a poem now.' " (grade 4 girl)

Controlling imagery. Intervention during this stage relied on audio-tapes and various visual stimulus such as flash cards to provide an opportunity for discussion of subjects' imagery experiences. In this phase, subjects were encouraged to image specific things. For example, flash cards of various objects, such as fruits, were shown and the children were asked to image the object in visual mode and other sensory modalities related to the pictures. In addition, audio-tapes were utilized with the same purpose in mind. During this phase, fewer children reported

images that "just popped in their heads". Almost all of the children were able to describe some sort of image that related to the stimulus. During Star Trek audio segment (Orlick, 1993b) the following two children reported experiencing visual images for the first time:

"I felt my body go up and down. I saw black, green, and white stars." (grade 1 boy)

"I think I saw me in a spaceship, catching up to a planet. I could sort see a ball." (grade 3 boy)

It is interesting to note that attending to visual images was not emphasized during Star Trek activity but rather children were encouraged to imagine in other sensory modalities, particularly to feel in their images.

Food Focus was an another activity used to nurture control of imagery skills. The children each had a food item, such as a single cheerio. Each child was to repeatedly alternate staring at the food item and imaging the item. Then they tried to draw the item while paying close attention to their mental image and visual perception of it. Finally, each child had to find their specific food item out of a pile of the same item. This activity was used to encourage children to effectively attend to their mental images. Almost every child was able to find their food item which may indicate at least some degree of success in

imagery control.

Utilizing imagery. During this stage of intervention, activities were aimed at using imagery skills to foster certain states or feelings and to aid in task performance. It was hoped that this would serve to provide practice for imagery skills and develop an appreciation for it.

Task Performance activities included obstacle courses and throwing accuracy tasks. During these activities the children tried to image themselves successfully completing the task prior to performing the task blindfolded. For example, children first walked through an obstacle course, sighted, then imagined walking through it, and then walked through it blindfolded. Though there was no objective measure of efficacy in these activities, the children appeared to be excited about their success in performance.

Guided imagery was used during this stage to foster good feelings about oneself and to nurture the self-transcendent quality of extending oneself outward to others. The children were guided by the "deer imagery" script (see Appendix IX) which led each child into a forest to rescue a trapped deer. Grade four, five, and six children (n=30) reported in writing detailed imagery in the describing their subjective experiences and feelings during the process. All children reported images in at least one sensory modality and a number reported multi-modal images, such as the following:

"I pet the deer and it felt so soft. When the deer left, I felt sad because the deer had to leave and I felt good because I helped the deer." (grade 4 girl)

"I heard the trees moving. I smelled the nice breeze. I found some raspberries and ate some of them. (grade 4 girl)

"I saw the deer and it had a white spot on its foot. I fed the deer lettuce. I could feel it but I couldn't smell it. I could also hear him chewing. (grade 4 girl)

"I saw the deer struggling to get out of the trap so I fed it a coconut and it tasted like real coconut. I heard it whimpering and its fur felt fuzzy and the coconut felt rough. I heard the deer thank me for helping him.
(grade 6 boy)

Other children reported that they experienced emotions during and after the deer imagery exercise:

When I freed the deer it ran to the parents with long horns. It made me feel so good that I had a little tear running down my cheek." (grade 4 girl)

"I felt proud and nice. I felt that the deer was thanking me. I fed him some apples. I tasted it before and it felt

crunchy." (grade 5 girl)

"It makes me feel helpful and proud of myself. At the end I was sad. It said thanks to me and he will miss me forever."
(grade 5 boy)

It made me feel calm because it took my mind off of everything bad." (grade 6 girl)

When it left, I felt sad but happy and when it looked at me I felt warm inside." (grade 6 boy)

The deer turned back and said thank you so much for saving my life and when you were done talking I felt warm inside."
(grade 6 girl)

One child reported a slightly different imagery experience in detail:

"Mine was a bit different. The deer was a big elephant and I fed him peanuts and I got them from a peanut seller. I could feel and smell them. The way it [elephant] was caught was that it's feet were tied up to trees. At the end the elephant gave me a ride on his back. It was really fun."
(grade 6 girl)

Only six children (n=30), responded in writing in the affirmative to the question:

Did your mind wander, to think of something else, while I was talking?

Twenty-three children reported that they maintained images of the story throughout the guided process without having their minds wander. Those whose minds wandered wrote that they temporarily were distracted with thoughts such as their "families" or "giving my speech". Only one child reported to have no images because of lack of focus.

During this stage, heart rate monitors were re-introduced. They were used in an exercise which had each child monitor the fluctuations in their heart rate by creating their own imagery. Each child imaged in different sensory modalities and recorded their heart rate. If they noticed a fluctuation from a baseline measure they recorded a description of their imagery. The children enjoyed the opportunity to work independently to see the possibilities their imagery could have on their physical state. Many children noticed from previous interventions that active kinaesthetic imagery could raise their heart rate while relaxing imagery lowered their heart rate. During this intervention they became aware that different images in other modalities could have the same effect. For example, one grade 6 boy could increase his heart rate by 12 beats\min when he imaged his mother's voice. Discussion with this boy revealed that he had not seen his mother for over a month and this image made him feel excited. A grade 5

boy reported that in auditory modality he increased his heart rate from 85 beats\min to 95 beats\min:

"I was hearing guns shooting. It was a war between the U.S.A. and Vietnam. There were bombs and explosions everywhere."

The researcher queried:

"When you could imagine those sounds, how did it make you feel?"

Boy: "It made me feel scared."

Researcher: "Have you ever really heard those sounds, like on television?"

Boy: "Well, I'm Cambodian, and when I was 5 there were guns and bombs going off and I was on my Father's shoulders and he was running. It was very scary."

This dialogue demonstrates the validity of one child's imaginal experience. It points out that images, even in less common modalities, can foster certain memories. At this latter stage of intervention, a number of children were able to image effectively and in high quality.

Qualitative Questionnaires

At the conclusion of the intervention program, experimental group children were given a program evaluation questionnaire and both control and experimental groups were given the imagery improvement questionnaire.

Imagery Improvement Questionnaire. All children who were involved in the study were given the Imagery Improvement

Questionnaire (Appendix X) during post-test and after the KIS, which asked children one question with room for a comment:

Do you think you can see pictures, hear, smell, taste, or feel yourself move in your mind, the same, worse, or better than you could 3 months ago?

Forty eight experimental group children and 56 control group children responded to this question. Sixty five percent of the experimental group children (31 of 48) reported improved imagery, while 50% (28 of 56) control group children reported imagery improvement. These numerical results were statistically compared to the change scores of the KIS Inventory but failed to show any significance. Intervention children were more likely to add comments:

"It's better because I get better images of stuff than last time." (grade 4 girl)

"I think it's better because before some of the things that I saw were blurry." (grade 4 girl)

"I think it's more fun than before." (grade 4 girl)

"Before I could see a little. Now I can see, hear, and smell better." (grade 5 girl)

"Before I came to the group I didn't exactly pay attention about mental imagery, so, yah, I can do it better." (grade 6 girl)

"I am better because it has boosted my confidence." (grade 6 boy)

"I am better because before I started, I didn't know how to use my imagery and now I do. So thanks for helping with my imagery." (grade 6 boy)

"Because now I can picture myself doing it better." (grade 6 boy)

There was one response from a grade 6 girl in the control group who reported improvement:

"It is better because I practice every day."

It is important to note that this study had no way of controlling for control group members who used imagery on their own. In fact, it is assumed that random assignment allowed for both groups to consist of "strong imagers" and "weak imagers".

Program Evaluation Questionnaire. All experimental group children were surveyed with an evaluative questionnaire (see

Appendix XI) regarding their feelings about the mental imagery program. Children from grades 1-3 were interviewed by outside researchers using the questionnaire as a format for asking questions. Pertinent information related to imagery development was extracted.

The children were asked open-ended questions about what they thought of the program. The children responded overwhelmingly that they liked the program. Twelve (n=59) children responded that the imagery program helped improve their imagery and had positive effects on their feelings, such as:

"It made me happy." (grade one)

"It was helpful to me. It helped me relax a lot." (grade 4)

"It was fun. I learned to see pictures in my mind." (grade 4)

"It got me relaxed for the rest of the day." (grade 4)

"I think it was a great program. I feel better and more relaxed." (grade 5)

"Excellent. It was good for me. I liked it." (grade 5)

"I thought it was fun and I know it will help me in the future. I hope to be an actor and imagining myself doing the

part will be helpful." (grade 6)

"At first I hated it, but then I learned how to do it."
(grade 6)

The children were asked if they had learned anything in the program. Fifteen (n=59) responded positively about imagery and uses of imagery:

"I learned about thinking and imagining." (grade 1)

"Yes, imagining, seeing and tasting in my mind." (grade 3)

"Yes I learned how many ways to use mental imagery."
(grade 4)

"Yes, you can always imagine things like sports." (grade 4)

"I learned how to use mental imagery to relax." (grade 4)

"I learned imagining stuff. If I wanted to do something then I imagined it and I'd do it better...like high jumping."
(grade 5)

Nine others responded that they learned a number of skills not directly dealt with in the intervention program but related to

mental imagery. This would demonstrate that the children experienced transferred skills from the curriculum of the intervention program:

"Yes I learned how to think things in my mind and how to imagine things in my mind when I'm reading a story."

(grade 3)

"Yes I learned how to concentrate." (grade 5)

"Lots of stuff. If you don't remember things just imagine."

(grade 3)

"Yes, I learned how to be relaxed and not be nervous."

(grade 4)

"I learned that if you are scared, just imagine yourself doing something." (grade 6)

The acquisition and refinement of mental imagery skills was a major goal of this study. It was hoped that children would also begin to use mental imagery skills and exercise outside the classroom setting of the intervention. When asked if they had done or used any of the activities on their own, approximately one third of the children responded in the affirmative (21 of 59). Though it would be preferable to have a higher number than

this, there were a number of interesting responses demonstrating the use of imagery in their daily lives:

"Breathing in and out when I was sick with a headache."
(grade 1)

"Yes, in the races, I was fast and won. I imagined myself skating fast and it made me run fast and win." (grade 1)

"Yes when I was sad I imagined I was a star." (grade 5)

"Yes, when I play baseball and I see myself play baseball. It helps me." (grade 4)

"Yes, when I was trying to get to sleep at home in my bed, I used it." (grade 4)

"Yes when I was going to dance at the National Arts Centre."
(grade 4)

"Yes, in lacrosse I imagined that I was going to score and I did." (grade 4)

"Yes, when I figure skate and when I draw pictures."
(grade 4)

"Yes. I used it for high jump, long jump, and 1500m."
(grade 5)

"Yes, I picture myself doing stuff, acting and singing."
(grade 6)

"I used mental imagery when I ran the 100m." (grade 6)

"Yes when I tried out for high jump." (grade 6)

Over half of the children (33 of 59) reported that they felt they would use mental imagery in the future. Areas for future application included sporting and artistic activities, dealing with stress and emotions, coping with sickness, when performing in front of an audience, when reading, and to aid memory recall. One grade 3 girl felt that she would use mental imagery as a guide in decision-making. She responded:

"When I have free time and someone asks me to go somewhere, I will imagine it first and then decide if I want to go."

Qualitative results were very encouraging with respect to opening the door for future research in this area. Overall, there was some indication that children's imagery skills had improved, that they had used imagery outside the program, that they had benefitted from imagery use, and that they intended on using

their imagery skills in the future.

V. DISCUSSION

Imagery development. The extent of imagery development was measured both quantitatively and qualitatively. Both approaches showed some evidence of improvement of imagery skills of the subjects, however quantitative instruments demonstrated a lack of improvement as well.

Quantitative methodology employed both subjective and objective measures in order to avoid the shortcomings of past research to exclusively rely on self-report tests (Sommer, 1980). This research, however, found mixed results therefore it should be interpreted with caution. The objective performance task (Ski Run Assessment Tool) showed significant improvement of imagery skills of experimental group children. The self-report inventory (KIS) adapted for children was utilized with success in terms of comprehension and administration. However, KIS failed to show significant improvement of imagery skills. These results might be interpreted as follows:

1. The self-report inventory showed little improvement of experimental group children, therefore the intervention was ineffective.
2. Self-report inventories are subject to the individual's interpretation and, because imagery is poorly understood and intangible, subjects may have had difficulty assessing their

own imagery (i.e. they confused mental images with retinal images). By the same token, performance tasks are objective and therefore are fair, and subjects' scores are consistently related to each other.

3. The Ski Run Assessment Tool revealed significant positive change in the performance of experimental group subjects, therefore the intervention was successful at improving children's imagery. This is strong evidence that imagery is a skill that can be developed.

4. Mixed results in quantitative measures was an indication of a failure to demonstrate an effective intervention. However, qualitative measures revealed a development of the imagery skills of experimental group children. This discrepancy was related to the inherent difficulty of imagery measurement and weakness of measurement instruments.

5. Self-report results were affected by mood\self-esteem. One's mood will affect their ability to image.

This correlation between mood and imagery is, however, an ambiguous connection and may be a reflection of the reliability or validity of the self-report measure.

In addition, it was apparent to the researcher that a number of children reported during the intervention to have improved their ability to image, yet the same children reported lower scores on the KIS. This might be an indication that these children developed a better understanding of imagery and

therefore were more likely to critically assess their own abilities. It is important to note that subjects were not shown their self-ratings from pre-test during post-test. Nevertheless, the failure to find a relationship between the subjective self-report inventory and objective performance test is consistent with past research (Ernest, 1977; Finke, 1989; Reisberg & Heuer, 1988) and is therefore an indication that further research is needed to refine imagery measures. This study also indicates the need to examine the validity and reliability of self-report inventories for children.

Qualitative investigation during the intervention process showed support for imagery development. During the initial stages of intervention, children became aware of mental images, and were able to perform imaginal tasks. Children grew in their skills to induce images, control images and focus specifically on desired images during the program.

Qualitative questionnaires in post-test revealed that children enjoyed the program and believed that it improved their imagery and helped them to feel better about themselves.

Effects of mental imagery. This study showed some evidence that the use of imagery and the intervention of imagery games and activities had some positive effects on children. Though most of the quantitative results of this research showed no significant effects, the Ski Run Assessment Tool was significant and qualitative investigation revealed that some subjects reported the following:

1. using imagery enhanced the performance of various tasks during intervention, including drawing, throwing for accuracy, and memory tasks.
2. using imagery enhanced the performance of various activities outside of the intervention, including sports, acting, and giving speeches in front of classmates.
3. after doing imagery activities, subjects felt more relaxed.
4. imagery use and the intervention helped subjects to deal with the stresses of the day, and in some cases helped them to forget about something that had given them negative feelings
5. imagery made them feel good about themselves and at least temporarily increased self-esteem
6. imagery had a direct effect on raising or lowering their heart rates.

Positive effects of imagery practice for children have often been experienced through qualitative investigation (Galyean, 1983; Waas, 1991), as was true for this research. Quantitative support for the benefits of imagery development for children is still limited.

Personal reflections. This research sought out to examine the extent to which an intervention program could improve the imagery ability of school-aged children. Though it was felt that imagery could be a useful tool for improved performance, stress

management and improved self-concept, it would have been premature to examine imagery's utility with no understanding of individual's ability to use it. The results of this study provide support for those who wish to test the efficacy of various interventions which aim to improve imagery ability, skilled performance or self-concept. Though the intervention of this study showed limited success, it might serve, at this point in time, as a starting point for modifying and improving.

Though some improvement in imagery was shown, I am not convinced that anyone can improve their ability to visually image. In other words, there may be individuals who do not have visual images and never will have visual images. At the same time, I am not convinced that they never can. Past research has indicated that more than ten percent of the population cannot visually image (Finke, 1989; Lazarus, 1984; McKim, 1980). The intervention of this study aimed to improve imagery, including visual imagery, of all children: even those who reported an absence of visual images. Unfortunately, the results of this research were inconclusive in their attempts to answer the question of whether non-visual imagers can evoke visual images after training. This remains as a question in the imagery field open for further inquiry.

Though there were individuals who did not improve their visual imagery, all experimental subjects reported images in other modalities at some point in the intervention and during post-test. In addition, all subjects experienced the

physiological effects of imagery (i.e. heart rate) and many reported positive mental\emotional states from imagery use. It is for this reason that the author believes that imagery can be used with all children provided that we consider the following:

1. Incorporate many sensory modalities, especially kinaesthetic, and avoid using terms like "see", "picture", and "visualize" when we discussing, encouraging and promoting mental imagery. It is advisable to use words such as "image" and "imagine".
2. Avoid behaviours that give any impression of evaluation. Facilitating imagery development is dependent on an open, trusting relationship between the facilitator and student. Honest and accurate feedback from the student can assist the facilitator to direct the student appropriately and plan suitable activities. If the student perceives that the facilitator is evaluating their imagery, it may be difficult to secure accurate feedback. Therefore, the facilitator should be careful to avoid passing judgements, such as giving superfluous praise as well as criticism, during discussion with students.

The intervention of this research was designed to utilize imagery activities only. Special attention was made to avoid overlapping with other mental skills, which may have affected the

validity of imagery measurement. The only other skill that was included was relaxation because relaxation is sometimes indicated to foster a better predisposition to vivid images (Lazarus, 1984). In addition, relaxation exercises incorporated mental imagery. Since imagery development was the focus of this research, these restrictions were necessary. These restrictions may have limited other potential benefits to subjects. Future research is needed without these restrictions. Intervention research including a number of mental skills such as focusing, refocussing, relaxation, and positive thinking, along with mental imagery might prove to have greater overall benefits to the development of children's mental well-being.

Though past research has indicated a number of benefits from imagery use, it was still unclear as to whether every child could experience these benefits because of differences in ability to image. Murphy and Jowdy (1992) cited differences in imagery ability as being a factor which has affected the efficacy of many imagery training programs. This study showed some support for the notion that imagery can be developed, therefore regardless of one's ability, positive effects can be experienced as long as educators pay specific attention to teaching imagery as well as utilizing it. Should educators include imagery in curricula, potentially important benefits could be realized. A number of the children who partook in this study expressed their thoughts of the important benefits of mental imagery:

"If you're hurt, you imagine something happy and you don't cry for long." (grade one)

"When you're skating and you want to do a new move, imagery helps you not to fall down." (grade one)

"If you lose something you can remember." (grade three)

"It helps you to relax. It helps you to not hesitate."
(grade four)

"It helps you to believe in yourself more." (grade five)

"When I go to bed, I imagine stuff--it helps me to sleep--imagining stuff like when I grow up, meeting friends."
(grade six)

"You can learn stuff about you you didn't know. It helps you to concentrate and feel like doing it before it happens."
(grade six)

One grade six child commented on the subjective and unique experience of imagery:

"I think it is important because you can see things maybe nobody can." (grade six)

Imagery, if reinforced appropriately, has the capacity to demonstrate the uniqueness and singleness of each individual. Viktor Frankl (1984) suggested this kind of uniqueness "gives meaning to [our] existence [and] has a bearing on creative work as much it does on human love" (p. 101). This study provides some support to past research that has indicated that mental imagery has the potential to promote mental well-being and reinforce both positive images of oneself and a vision of one's potential (see Barr-Johnson, 1982; Gaylean, 1982, 1983; Lazarus, 1984; Li-Wei, Qi-Wei, Orlick & Zitzelsberger, 1992; McKim, 1980; Rodgers, Hall & Buckolz, 1991). However, further research is needed in order to fully understand the extent to which school-aged children can benefit from an imagery intervention program.

The most important finding of this study was that an imagery intervention program was shown to have some positive effects on the development of imagery. This would provide support to those who lobby for the inclusion of imagery development in school curriculums. It is hoped that the information from this study will stimulate future research to examine the possibilities and potential for an imagery development curriculum to be included in the education of young children.

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APPENDICES

Seeing

Name: _____

In my mind:



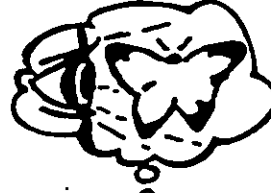
I can't see anything



I think I see something but I'm not sure what it is



I see it a little



I see it pretty clearly



I see it really clearly - like it's real

Hearing

In my mind:



I can't hear anything



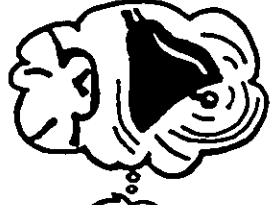
I think I hear something but I'm not sure what it is



I hear it a little



I hear it pretty clearly



I hear it really clearly - like it's real

Smelling

In my mind:



I can't smell anything



I think I smell something but I'm not sure what it is



I can smell it a little



I can smell it pretty well



I can smell it like it's real

Taste

APPENDIX II

In my mind:



I can't taste anything



I think I taste something but I'm not sure what it is



I can taste it a little



I can taste it pretty well



I can taste it like it's real

Moving

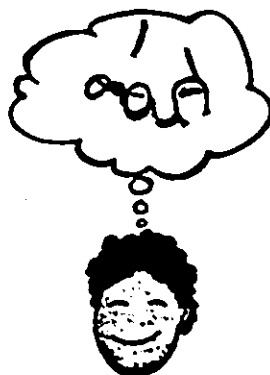
In my mind:



I can't feel anything



I think I feel my body moving but I'm not sure



I can feel my body move a little



I can feel my body move pretty well



I can feel my body move - like it's real

Touch

In my mind:



I can't feel anything



I think I feel something but I'm not sure what it is



I can feel it a little



I can feel it pretty well



I can feel it like it's real

Feeling Confident and Strong

In my mind:



I can't feel anything

I think I feel something but I'm not sure

I feel a little strong

I feel pretty strong

I feel really strong and confident

Moving

In my mind:



I can't feel anything

I think I feel my body moving but I'm not sure

I can feel my body move a little

I can feel my body move pretty well

I can feel my body move - like it's real

Feeling Relaxed

In my mind:



I can't feel anything

I think I feel something but I'm not sure

I feel a little relaxed

I feel pretty relaxed

I feel really relaxed

Feeling Happy

In my mind:



I can't feel anything



I think I feel happy but I'm not sure



I feel a little happy



I feel pretty happy



I feel really happy

Helping or being nice to others

In my mind:



I can't see anything



I think I see it but I'm not sure



I see myself helping others a little



I see myself helping others pretty well



I really see myself helping others

Helping or being nice to others

In my mind:



I can't feel anything



I think I feel it but I'm not sure



I feel myself helping others a little



I feel myself helping others pretty well



I really feel myself helping others

APPENDIX V

["SKI RUN" ASSESSMENT TOOLS]

Blind Skiing:

[Hand out ski run]

"Everybody put your name at the top of the sheet here.

[wait until they are done]
[hand out blind folds]

"Everyone put blind fold on your forehead like this... and leave it like that.

[demonstrate]

"We're going to play a fun little game called Blind skiing. Everybody look at the ski hill and let your eyes follow from top to bottom 3 times. Now let your eyes follow and move your finger down the ski hill at the same time. Do that twice. [demonstrate].

"Now close your eyes and see a picture in your mind of the ski hill and in your mind move your finger down the ski hill.

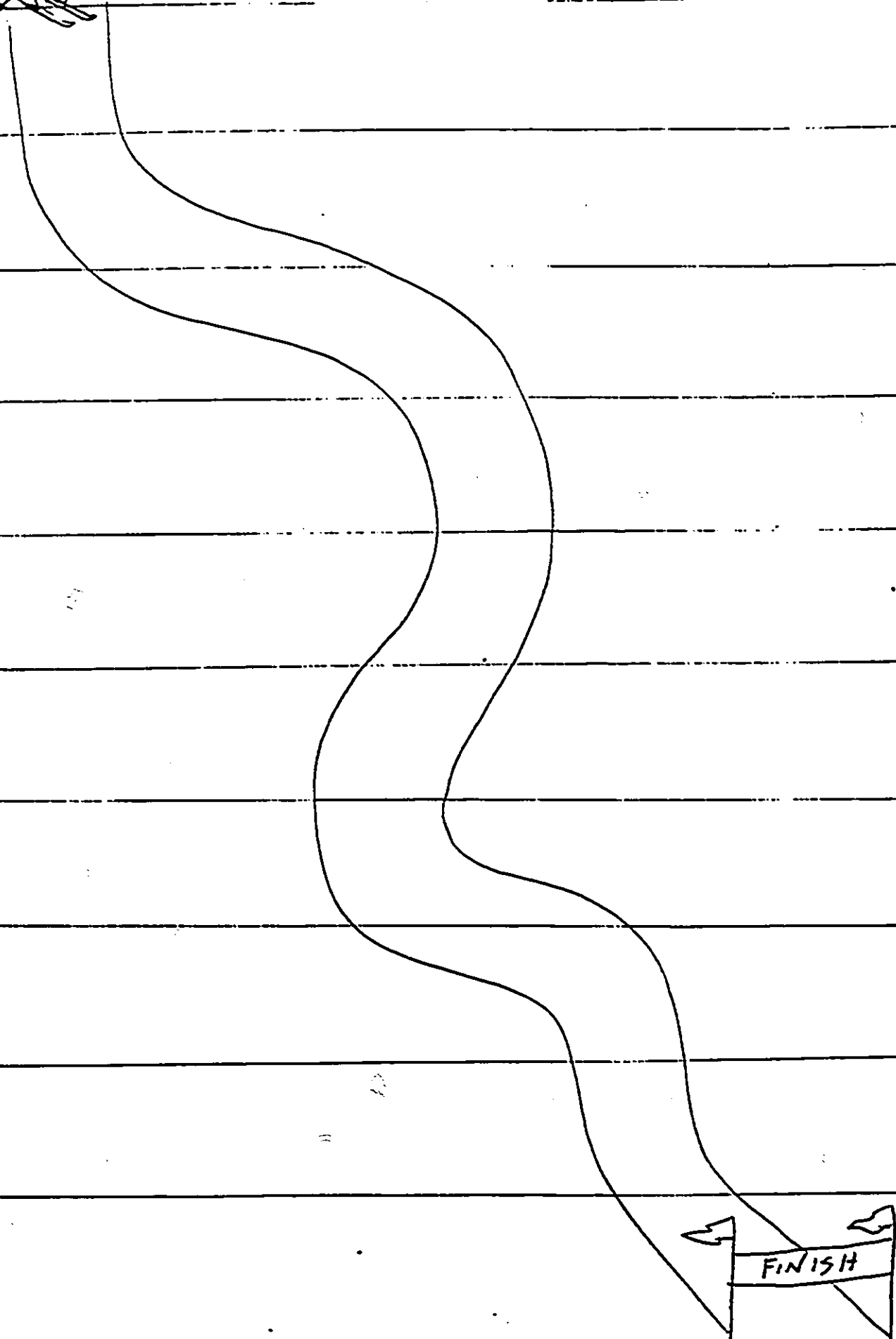
[silence for 15 seconds]

"Now open your eyes. Pick up your pencil and place it right on the skier [demonstrate]. With your other hand pull down the blind fold--and now run the pencil down the ski hill and as you do it try to see the ski hill in your mind, but don't look for real. When you think you have finished drop your pencil.

[collect the papers immediately after they have all finished]

Name _____

~~LOOPY~~
START
HERE



FINISH

How I FEEL TODAY.



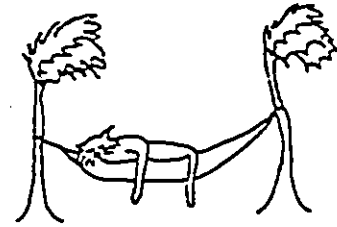
Very Stressed



A Little Stressed



A Little Relaxed



Very Relaxed

Which face is me today?



I am very sad



I am a little sad



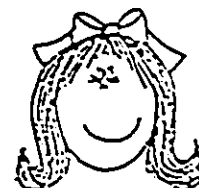
I am in between



I am happy



I am very happy



How I feel about me today.



I feel down about me today



I do not feel good about me today



I feel o.k. about me today



I feel good about me today



I feel great about me today

APPENDIX VIII**INTERVENTION SCHEDULE AND DESCRIPTION****Stage I: AWARENESS****Intervention One "Video Imagery"**

Subjects were asked to view a number of scenes on a video. Typically, the scenes were of animals and were a few seconds long. The first scene was a still photo on video. After viewing each scene, subjects were asked to close their eyes and to try to imagine the scene in their mind. After imaging each scene, discussion followed asking children "What did you see in your mind?", "Was it like the video?", and "Did you want to imagine what was in your head?". The goal was not to imagine the exact image of the video but rather to make students aware of mental pictures. Special attention was made to secure honest answers.

Intervention Two "Alphabet Game"

The goal of this intervention was to provide evidence to subjects that they do in fact use mental images. All subjects were familiar with the alphabet. To be sure, subjects were asked to say the alphabet in unison. Then, the interventionist visually distinguished short letters (e.g. "a", "c", "e", etc.) from the long letters (e.g. "b", "d", "f", "g", etc.). Subjects were subsequently asked to vocalize the small or long letters individually, without a visual stimulus.

Intervention Three "Bubble Letter"

Subjects were shown a block letter, and each corner of the letter was identified as being at the extreme top or bottom or not at the extreme top or bottom. Subjects were then asked to indicate with a "yes" or "no" if each letter was at the extreme top or bottom, beginning at the lower left corner of the letter and moving clockwise. This was done without a visual stimulus. After the above two exercises, discussion followed as to how such a task is possible.

Intervention Four "Soaring Video"

Subjects were shown a video of a oceanic landscape, filmed from an airplane. Subjects were asked to view the video and then image themselves moving over the water themselves. This intervention was used to create awareness of and to foster kinaesthetic imagery. Discussion followed.

Intervention Five "Visualization Video"

A video of successful Olympic athletes using imagery was shown to students (Botterill & Orlick, 1987)

Stage II: INDUCING IMAGERY**Intervention Six "Audio tape: Soaring"**

Soaring audio segment from Orlick's Free to Feel Great audio cassette was used to induce images of one's body moving through space. Subjects were asked to imagine simultaneous to listening

to the tape. Discussion followed.

Intervention Seven "See, Feel, and Smell & Imagine Drawing"

Three stations (booths) were set up with an object in each booth. Subjects were to enter each booth, one at a time. The first booth, called "See, Imagine and Draw" had an object in which the students were to view until they had a clear image in their mind of it and then they had to exit the booth and draw the object without the visual stimulus. The second booth was called "Feel, Imagine and Draw", and students were to enter the booth blindfolded. Here, they were to feel the object in order to foster a mental image of the object, and then they exited the booth and attempted to draw the object based on that mental image. The third station, "Smell, Imagine and Draw", had an object with a distinct smell. Students smelled the object in order to foster a mental image of it so that they could, again, draw the object.

Intervention Eight "Object Draw"

This activity was similar to "Feel, Imagine and Draw". Three booths were set up with an object in each booth. These objects were somewhat abstract, therefore they were not easily discernable. This compelled students to feel attentively and to conscientiously attempt to create an image of the object because drawing the object would be difficult with no prior knowledge of what it might look like.

Intervention Nine "Sound Listening I & II"

Sound Listening I (Orlick, 1993b) was used to foster images in various sensory modalities. Students were told to pay close attention to seeing, feeling and hearing it in the mind. Discussion followed related to the content and quality of each individual's imagery experiences.

Sound Listening II (Orlick, 1993b) was then played. Students were instructed to mentally image the sounds in various sensory modalities but to not see images. This was used as a paradoxical intention in order to see if some individuals could actually see better when told not to.

Intervention Ten "Heart Monitors"

Heart monitors were used to record the heart rate of the children during relaxing and activating imagery. Audio tapes (Star Trek and Special Place, Orlick, 1993b) were used as a stimulus for both types of images. Heart rates were compared to a baseline measure.

Stage III: CONTROLLING IMAGES**Intervention Eleven "Flash Cards"**

Flashed cards of various fruits and vegetables were used to prompt imagery in various sensory modalities. The activity involved group discussion.

Intervention Twelve "Audio Tape: Imagine Game"

Imagine Game (Orlick, 1993b) was used to foster specific images like "an animal with a tail".

Intervention Thirteen "Food Focus"

"Food Focus" is a game where students each receive a food item (e.g. a cheerio), and stare at it until they have a clear image of it. Subsequently, children had to pick their food item out of the pile of same item. A further step was added where children had to stare at the item, image the item and draw the item. Children could then alternate viewing the item and imaging it in order to compare their images to the drawing. This was used to help children improve the quality of their images.

Intervention Fourteen "Sea of Tranquillity"

Sea of Tranquillity (Orlick, 1993b) is an audio piece with relaxing music and dialogue to foster pleasant images. Discussion followed related to the quality of students' images.

Intervention Fifteen "Blind Sculptor"

Children are in groups of three. They take turns assuming three roles: sculptor; lump of clay; and model. Both the sculptor and the lump of clay are blindfolded. The model assumes a static position like a statue and the sculptor feels the arms, legs and head of the model. The sculptor, then molds the clay in the image of the model. Once completed, the blindfolds are

removed and children can compare the visual images of the clay and model to the mental images.

Stage IV: UTILIZING IMAGERY

Intervention Sixteen "Obstacle Course"

Various obstacles were set up for which children had to walk through first, image walking through second, and walk through blindfolded third. A number of other tasks were involved, such as setting up a configuration of wooden blocks similar to a configuration set up as a model (children had to feel the model configuration and set up another set of blocks in a similar configuration based on their imagery induced by feeling), and ball bouncing (paying attention to the sound of the bounce to induce images of the ball).

Intervention Seventeen "Accuracy Throw"

Various baskets and targets were set up for children to practice throwing balls in\at for accuracy. Children were encouraged to image both visually and kinaesthetically before throwing. This task was done blindfolded and without blindfolds.

Intervention Eighteen "Soft Bowling"

A large wooden block was placed at a distance as a point for children to aim at. Rather than knock over the block, children were told to roll the ball softly in order to get as close to the block without touching it. Children were encouraged to imagine

the feel of a soft gentle throw before they rolled the ball.

Intervention Nineteen "Deer Imagery"

Guided imagery of saving a trapped deer (see Appendix IX) was used to foster good feelings about oneself and to develop the self-transcendant quality of extending oneself outwardly to someone or something else. Students were then asked to describe their imagery experiences and to discuss the extent to which they could stay focused on the imagery without wandering thoughts.

Intervention Twenty "Heart Rate in Different Modalities"

Students from grades 4-6 worked independently with the heart monitors to create images in various sensory modalities to see if this could affect their heart rate. If their heart rate fluctuated, they would record the rate and a description of the image. In some cases students also recorded their feeling about those images. Grades 1-3, were more closely supervised by an interventionist.

Other Interventions

Other days of the intervention period were repeats of various activities, or cancelled classes because of conflicts with regular school programming. Also note that interventions didn't necessarily follow this order, but were organized to achieve the goals of the 4 stages.

APPENDIX IX

Guided Imagery Script: Deer Imagery

Get into a comfortable position...close your eyes and imagine what I am saying as I say it.

You are walking through the woods and you see a baby deer, a fawn, its leg seems to be trapped under a big log and it is frightened. You cannot free it because it is too frightened and is moving about frantically. You decide to find something for it to eat so that you can show it that you are friendly and want to help it.

You walk about 100 metres and you finally find something you think it will eat...it can be anything you want because it's your imagery...see it...what is it? Smell it...feel it in your hands...if it is the kind of food that you don't mind eating, then taste it. You take it back to the fawn, slowly it takes it from your hands...then it licks your hand.

Now with all your strength and all your might, you move the log that is trapping its leg. You are struggling with the log to move it...at last the fawn is free.

It starts to move around...slowly...with a limp...it is moving a little better...and now it moves more freely and it is jumping around, free and happy.

It wants to play so you play with it...watch how you are playing with it...

You see a herd of deer in the distance and know that it is time for the fawn to go...it comes up to you and rubs its head on

your leg, it's telling you that it likes you. The fawn takes a few steps away from you...it now sees the other deer and starts to run towards them...it stops and turns its head back...it looks you straight in the eye as if to say something and it runs off...see it go to safety.

Think about how you feel right now.

Now slowly open your eyes.

APPENDIX X

Name _____

Question

Do you think you can see pictures, hear, smell, taste, or feel yourself move in your mind, the same, worse or better than you could 3 months ago? (CIRCLE)

SAME

WORSE

BETTER

Explain:

APPENDIX XI

WE WOULD LIKE TO KNOW:

1. What did you think of the imagery program that we did?

2. Is there anything you disliked about the program?

3. Did you learn anything?

4. Have you done or used any of the activities on your own outside this room? If yes, when?

5. Have you taught or shown anyone anything about mental imagery? If yes, what?

6. Do you think imagery is important? Why or why not?

7. Do you think you'll use imagery now that our program is finished?
When?

RESEARCH PROPOSAL:

The Development and Effects of Mental Imagery Training
for Primary School Children

Stephen G. Howlett

University of Ottawa

I. INTRODUCTION

Recent research has shown that top athletes possess a number of superior mental skills (McCaffrey and Orlick, 1989; Orlick and Partington, 1988). Along with other skills, athletes have been shown to have advanced abilities in mental imagery. In addition to possessing this ability, superior athletes claim to devote a great deal of time using and practising mental imagery (Orlick & Lee Gartner, 1993).

Research has not been limited to athletes only. Recent studies have examined the mental traits of other high performance professions including surgeons (McDonald & Orlick, 1992), classical musicians (Talbot-Honek, 1993), and architects (Sommer, 1980). All have found that elite performers in each of these fields have tremendous imagery ability.

A number of studies have shown mental imagery to enhance and improve performance achievement in both physical (see Li-Wei, Qi-Wei, Orlick & Zitzelsberger, 1992) and mental tasks (see Finke, 1989)).

There have been claims that mental imagery is useful in stress reduction, goal setting (Orlick, 1992), improving self-esteem and having positive self-images, and healing (Ievleva & Orlick, 1991; Simonton & Mathews-Simonton, & Creighton, J., 1978).

Considering the usefulness of this skill, should educators not aim at improving mental imagery? Educators in the field of sport psychology have endeavoured to improve imagery in athletes and to

devise plans to do so (Albinson & Bull, 1988; Orlick, 1986), yet surprisingly, little has been written about the effectiveness of such intervention programs. Perhaps more importantly, with exception of recent studies with figure skaters (Mumford, 1992; Rodgers, Hall, & Buckolz, 1991) there has been little to demonstrate that imagery is a skill that can, in fact be developed.

The goal of this research is to examine the issue of mental imagery development. More specifically, it is hoped that we can answer the question: can an intervention program of imagery [games and activities] foster improved imagery ability among "normal" elementary school children?

The answer to such a question would have important implications for the field of sport psychology and education. Positive results would give support for the early development of mental skills in school and sport, by teachers, coaches, and mental training consultants who endeavour to facilitate improved mental skills for the children\athletes with whom they work. In addition, if imagery is an ability that can be nurtured successfully at an early age, then educational institutions should give serious consideration to its inclusion in school curriculums. Perhaps it can be directed towards improved learning and quality of life.

II. REVIEW OF LITERATURE

Definition of Mental Imagery

There have been numerous books and articles written on the subject of mental imagery. In view of the fact that this topic is extremely complex and subjective, the existing literature has created quite a divergent view of imagery making it a rather confusing subject. In order to simplify the concept, a working definition is in order. Mental imagery is defined as "the mental invention or recreation of an experience that in at least some respects resembles the experience of actually perceiving an object or an event, either in conjunction with, or in the absence of, direct sensory stimulation" (Finke, 1989).

Most people believe that they can form mental images. Nevertheless, it is problematic to prove that images can be differentiated from "ordinary" thoughts that might be considered as "self-talk". It is believed, however, that the brain does in fact store information through these two distinct modes (Paivio, 1971). Images are a type of code for information storage which may exist in one or more sensory modality (see Betts, 1909, for a description of the modalities). The brain also stores information through verbal codes, that is, actual words in a particular language. Together, images and verbal representations comprise what Paivio considers as the dual-code theory. Paivio's theory is a simple way of considering possible ways in which people may problem solve. Some may produce words in the mind as if talking

to oneself, whilst others may formulate mental images.

Finke (1989) demonstrates some simple examples to illustrate that we do form mental images. For example he suggests that we consider the following questions: What color is the stripe of the American flag? Did Thomas Jefferson have a beard? (Finke, 1989, p. 3) A more scientific method by Brooks shows that providing a visual stimulus can, in fact, interfere with mental imaging (Brooks, 1968). Subjects were asked to recall a block letter and verbally indicate in sequence, with a "yes" or a "no" whether each corner of the block letter was at the extreme top or extreme bottom. Subjects were then asked to do the same task however, the second time they were to indicate their answers by pointing to the word "yes" or the word "no". Brooks found that the visual stimulus of locating the words "yes" or "no", interfered with the mental image of the block letter and therefore subjects were significantly slower in task performance the second time.

Application of Mental Imagery

The issue of mental imagery becomes particularly relevant when discussed in the context of its advantages and benefits to various fields that have been studied. Various fields in which mental imagery has been reported to be useful are discussed below.

Psychological therapy. Imagery has been used for a number of clinical purposes (Sheikh, 1983; 1986). It was believed that in conjunction with relaxation, images could be cathartic in nature

(Frank, 1910, cited in Sheikh & Jordan, 1983). Guillery (1945, cited in Sheikh & Jordan, 1983) found a correlation between imagery and a number of physiological responses. With this in mind, a therapist could encourage a client to call upon imagery to resolve conflicts in order to produce psychophysical harmonization. Imagery has also been used in the exploration of the unconscious (Kosbab, 1974, from Shiekh & Jordan, 1983); as a creative process of the psyche employed to attain greater individual, interpersonal and spiritual integration (Jordan, 1979); in dealing with fears by having the client imagine how he or she would like to act in a situation where the fear exists (Wolpin, 1969); and for the purpose of diagnosis similar to the Rorshach test (Sheikh, 1983, ch. 13).

Healing. A number of studies have shown that mental imagery can induce several physiological responses such as salivation (Barber, Chauncey, & Winer, 1964), changes in pupillary size (Simpson & Paivio, 1966), heart rate (May & Johnson, 1973), and increases in blood-glucose, inhibition of gastrointestinal activity, blister formation, and alterations in skin temperature (Barber, 1978). Given that physiological change is possible through imagery use, a number studies proceeded to examine if imagery could aid in producing positive rehabilitative results. Ieleva and Orlick (1991) demonstrate that a positive mental approach including mental imagery, fostered enhanced healing. Others have provided evidence supporting the use of imagery in the treatment of cancer (Fiore, 1983; Simonton, Mathews-Simonton,

and Creighton, 1978), and in the rehabilitation of illnesses and injuries such as ulcers, paraplegia, fractures, hip disarticulations, and intra-abdominal lesions (Korn, 1983).

The arts. Imagery in the arts is relevant for both the artist and the art audience. Fine arts, music, drama, and literature evoke sensory perceptual images (Lindauer, 1983). In addition, Child (1978) states that the imagery in art has emotional and pleasurable consequences for those who experience it. Imagery has important consequences for the artist as well. Artists in various fields of art have reported extensive use of mental imagery in their work (Lindauer, 1983).

Sports. Sport psychology, though still in its emerging stages, is a world-wide phenomenon which is experiencing a great deal of enthusiasm and interest in the sporting world (Salmela, 1984). Much of the work in the applied field of sport psychology evolves around the use of mental imagery in preparation for performance.

A number of studies have shown that top athletes have highly developed imagery skills (Kreiner-Phillips & Orlick, 1992; McCaffrey & Orlick, 1989; Orlick & Partington, 1986; 1988). Hemery (1986) reports that 80% of a selected group of the world's top athletes use visualization in their preparation for performance. Another study of top Canadian Olympic athletes reports that 99% use imagery in their preparation (Orlick & Partington, 1988).

In order to enhance performance, an athlete will reconstruct

past events through imagery in order to correct mistakes or the athlete will produce potential events as if practising and preparing for real life situations in sport (Suinn, 1983). There is evidence to support the claim that athletes who are highly skilled in their imagery (or perhaps have more control over their imagery) notice greater gains in performance after the mental practice of imagery (Clark, 1960; Start & Richardson, 1964) Because imagery is considered a skill, many athletes practice their imagery in order to improve it (see Orlick, 1986). There is however, little direct evidence to show that imagery is a skill that can be improved. Mumford (1992) reported that an intervention program of mental skills was somewhat successful in improving the imagery abilities of young female figure skaters. Yet there is little in the literature with regard to research that focuses solely on the skill of mental imagery. One such study (Rodgers, Hall & Buckoltz, 1991) found significant improvement in visual imagery but not kinaesthetic imagery following an imagery training program. Though this evidence is encouraging, more research is needed in the area of imagery skill development, and the development of imagery in other sensory modalities.

Mental Imagery and Human Excellence

Orlick (1992) proposes a model of the psychological factors necessary for achieving personal excellence based on the experiences of top performers. The seven basic elements of

excellence include commitment, belief, focus, mental readiness, distraction control, constructive evaluation and positive images. According to Orlick, top performers effectively use mental imagery skills in such a way as "to create positive feelings about one's capacity, to pre-experience and re-experience positive actions, events, or performances, and to experience the feelings and sensations which accompany the successful execution of important procedures, skills or actions" (p.115). Orlick goes on to credit top performers with having high quality images and provides references to support this claim.

It is important to note that many top performers did not use imagery prior to achieving their status. One highly recognized surgeon noted: "When I first began, I was less into imagery. Of course then my contingency plan preparation was far less elaborate than it is now" (McDonald, 1992, p.40). What is of particular significance in the study of top performers is that many did not initially have good control over their imagery. In a qualitative study of top athletes, one highly successful Olympic diver reported: "It took me a long time to control my images and perfect my imagery, maybe a year, doing it every day" (Orlick & Partington, 1988, p.114).

The study of excellence can provide some important models for educational purposes--and imagery, being an important component, should be given consideration when designing educational programs. Though the literature is lacking with regards to the extent to which children use imagery to perform tasks, there has

recently been research that indicates that children can benefit from imagery training (Li-Wei, Qi-Wei, Orlick & Zitzelberger, 1992). This study demonstrated positive performance effects in table tennis for children 7-10 years old as a result of imagery training. What remains to be investigated is the extent to which "normal" children can develop and improve their imagery skills. Considering the potential benefits that children can experience from the use of mental imagery, it would be prudent to examine the prospects for teaching this skill, including an evaluation of an imagery intervention program.

Research on Mental Imagery

Based on the review of literature, important implications for future imagery research lie in both the development of imagery as a skill and imagery with children. Though there has been much written on imagery, it remains as an extremely challenging subject to investigate. Therefore, in this section, some issues related to imagery research are briefly discussed.

To determine the extent of development of any skill, one needs a useful instrument to measure the skill. Ideally, that instrument can be used before and after an intervention program aimed at improving the skill. Negative results might only indicate that the instrument was not sensitive enough to assess change or that the intervention was poorly designed or poorly executed. Positive results would, however, indicate that the skill is one that is capable of development, assuming that the

instrument was clear and understandable. Skilled imagery is often referred to as including vividness, completeness and control. Measuring imagery vividness is an extremely challenging task. Ahsen (1985, cited in Reisberg & Heuer, 1988) explains about the difficulties associated with this field of study:

"Imagery, by its nature, is a subjective, private phenomenon, complex in its aspects, and, more often than not, in a state of rather fluid change. This clearly creates difficulties for the scientific study of imagery, given the need within science for a precise, objectively verifiable characterization of the phenomenon under scrutiny." (p.89)

Due to imagery's internal subjective nature, there is no way to directly assess or quantify it (Reisberg & Heuer, 1988). The strengths and weaknesses of various methods of measurement are discussed succinctly by Sommer (1980):

"Personal interviewing rates high in understanding and elaboration of responses, but poorly in objectivity, control, and economy...Self-report may still be useful in clinical practice or in idiographic studies, but its utility in research is limited by its low correlation with behaviour. Performance tests in such areas as educational and industrial psychology do correlate with behaviour. However, their predictive value is better for groups than for individuals." (p.118)

Marks (1973), in a study on memory performance, claims to have

found a relationship between memory tasks and self-report vividness measures. Based on these results, Marks concludes that images have an important role in memory. Nevertheless, caution should be exercised in considering these findings. When evaluating performance measures we should consider whether the task demands imagery skills or is simply aided by it (Reisberg & Heuer, 1988). For the case of memory, the latter is more likely to be true. Therefore doubt is cast upon Marks' results: it is unclear whether the self-report validates the performance task of memory or if it is the other way around. In Marks' experiments, those who scored high in memory tasks may have used a more complex system of coding not involving mental images. There is no way of knowing. The only revelation here is that self-report tests were not invalidated. In addition, the kind of memory tasks used have only incorporated visual images (Marks, 1973). A performance task involving more than one modality might provide more information.

In research with children, memory tasks might create practical problems. In pilot work for the study proposed, we observed that memory tasks were perceived to be similar to academic tests which create a certain amount of anxiety in children. This is a variable that would be difficult to control in memory tasks. Due to these pitfalls, it would be best, perhaps, to avoid memory tasks to evaluate imagery.

When analysing various measures, it is inevitable to keep coming back to self-report assessments because they are currently

the only tool that specifically measures an internal process like mental imagery. If we ask the right questions and are able to secure honest answers from participants, then self-report can make a significant contribution. For many years, the Betts' Questionnaire Upon Mental Imagery (QMI) has been the most comprehensive test of imagery ability (Sheehan, 1967). The QMI measures imagery ability in seven sensory modalities: visual, auditory, cutaneous, kinaesthetic, gustatory, olfactory, and organic (Betts, 1909). Due to the prohibitive length of the QMI, a shortened version has since come forward and has shown to produce similar results (Sheehan, 1967). Sheehan's Shortened Version of the Betts' QMI remains as one of the more widely used and reliable measures of imagery ability. Sommer (1980) argues that a more fruitful strategy in assessing imagery ability would be to combine self-report with other measures. It would be prudent to explore new objective measure, such as a valid performance task, to be used in conjunction with a self-report such as Sheehan's Shortened Version of the QMI.

Self-report tests have been administered with some degree of success, yet these self-report questionnaires have been designed and validated with adults in mind. All available questionnaires such as the QMI have been in written format and in adult language. No validated measures have been designed in order to be well understood by children.

III. RESEARCH METHODS

It is the intention of the proposed research to obtain data related to the development of imagery in children. An imagery intervention program will be implemented with the goal of improving mental imagery ability. Pre-test and post-test measures will be administered in order to evaluate and compare imagery ability prior to and following the independent variable (imagery intervention program).

Subjects

The proposed research will focus on primary school children in grades 1 (there will be two grade one classes), 3, 4, 5, and 6. The subjects in each grade will be from one classroom, and all will have had the same teacher throughout the school year. Each class will be divided into two equal groups: experimental (E) and control (C).

Both E and C will be randomly assigned with approximately equal numbers of both gender.

Method

Instruments. Methodology will include a triangulation of the data from three sources:

1. Self-report Inventory (designed for children)
2. Overt Performance Task (requiring imagery)
3. Qualitative Reporting (during intervention) and Questionnaires (post program)

A self-report inventory, called the "Kids Imagery Scale"

Inventory or KIS Inventory (see Appendices I,II,III, IV) was developed to assess imagery following the basic model of the Children's Skimetric Differential (Orlick, Partington, Scott & Glassford, 1975). It is primarily pictorial in nature, with brief accompanying written descriptors in language comprehensible to children, and containing similar modalities to adult assessment tools such as the Bett's QMI. The experimenter will present, explain, and guide subjects through the inventory with verbal instructions, using descriptors derived from children during pilot research.

A quantifiable performance task designed for this study will be administered. The task is called the "Ski Run" Assessment Tool (see Appendices V, VI). The subject is asked to engage in the following steps:

- 1) visually attend to a patterned representation of a path ("ski run"),
- 2) image the path while closing their eyes,
- 3) image themselves tracing the path while actually moving their finger over the path, and
- 4) trace the path with pen or pencil while blind-folded.

The path is divided into ten sections to later be used to empirically score the Subject's performance on this task. If the Subject's drawing remains completely on the path within a particular section they score 1 point. For each section where the subject is partially on the path they would score 0.5 points. If they fail to touch the path in a particular section they score 0 points. Each section's score is added to give a total performance score out of a possible 10 points. A floating transparent scoring

devise will be used, in order to credit a drawn pattern which closely replicates the desired pattern and yet fails to fall on the path.

Qualitative interviews similar to those used by Mumford (1992), will be conducted during post-test phase, with a cross-section of subjects of the study in an attempt to gain more in-depth information about their imagery experiences.

Intervention. A selected number of games and activities (see Orlick, 1993, for examples of activities) will be taught to children during 15 min. segments during regular school days. The intervention will occur 3 days per week for 10 weeks. Activities will be designed and planned in advance with allowances, in the latter stages, for modifications and new ideas.

Procedure

Pre-test. The KIS Inventory and Ski Run Assessment Tool will be administered over three days. Administration of these tests will include all subjects as experimental (E) and control (C) groups will not have been determined at the point of pre-test.

Intervention. Once subjects have been assigned to E or C, E will be exposed to the intervention of imagery games and activities (independent variable).

Post-test. The instruments used during pre-test will be re-administered to children from E and C simultaneously over a 3 day period. Qualitative interviews will also be conducted during this phase in order to provide more in depth information.

Data Analysis

Pre- and post-test measures will provide quantitative data. Appropriate statistical analysis, such as an analyses of variance and covariance (similar to that used by Miller & McAuley, 1987) will be employed in order to determine whether changes occur over the course of the study. In addition, Pearson product moment correlation of the KIS Inventory scores and the Ski Run Assessment Tool will be calculated to determine the relationship between the subjects' self-report on their imagery ability and imagery ability based on performance. Correlation of these two test measures will insure validity of these test measures.

Finally, relevant interview data will be quantitatively analyzed during post-test following the procedure utilized by Mumford (1993), and Orlick and Partington (1988).

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