EFFECTS OF VIRTUAL REALITY ON SYMPTOM DISTRESS IN CHILDREN RECEIVING CANCER CHEMOTHERAPY

by

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Abstract

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The objective of this study was to test the premise that virtual reality, as a developmentally appropriate distraction intervention, mitigates chemotherapy related symptom distress in older children with cancer aged 10 - 17. Treatments for cancer are intensive and difficult to endure even for mature adults who have developed effective coping skills. The use of distraction as a coping mechanism for cancer patients is well documented in the literature. Distraction interventions are effective because the individual concentrates on pleasant or interesting stimuli instead of focusing on unpleasant symptoms.

Virtual reality as a distraction intervention is both immersive and interactive. It is a computer simulated technique allowing an individual to hear and feel stimuli that correspond with a visual image. For this study the subjects wore a commercially available head set which projected an image with corresponding sounds. The sense of touch was involved through use of a computer mouse.
A synthesis of Lazarus and Folkman's (1984) stress and coping theoretical framework and a model of the self-sustaining process in adolescents (Hinds & Martin, 1988) was used to guide the study. An interrupted time series design with removed treatment was used to answer the following research questions: 1) Is virtual reality an effective distraction intervention for reducing chemotherapy related symptom distress in children? and 2) Does virtual reality have a lasting effect? Hypotheses: 1) There will be differences in measures of symptom distress in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments. and 2) There will be differences in measures of symptom distress two days following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

The convenience sample consisted of 11 children receiving outpatient chemotherapy at a clinical cancer center. Measures of symptom distress were obtained at nine time points during three consecutive chemotherapy treatments. Four indicators were used to measure the dependent variable of symptom distress. The Symptom Distress Scale
(SDS) (McCorkle, R. & Young, K., 1978) was considered a general indicator. Specific indicators of symptom distress included the State-Trait Anxiety Inventory for Children (STAIC C-1) (Speilberger, 1970) and single item indicators for nausea and vomiting. Reliability and validity of both the SDS and STAIC C-1 are well established.

Repeated measures analysis of variance procedures were used to test the hypotheses. A significance level of .10 was selected for hypothesis testing. Data analysis of the SDS suggested that the virtual reality intervention was effective at reducing the level of symptom distress immediately following the chemotherapy treatment (p<.10), but did not have a lasting effect. Analysis of the STAIC C-1 demonstrated high levels of anxiety during the initial chemotherapy treatment which decreased during the two subsequent treatments. State anxiety levels were not influenced by the virtual reality intervention.

A qualitative evaluation of the virtual reality intervention was completed by all subjects. The responses suggested that the virtual reality experience provided an effective distraction that was easy to use. Eighty two percent of subjects indicated the chemotherapy treatment with the virtual reality equipment was better than previous treatments and none of the subjects indicated that the virtual reality made them feel worse. All subjects responded that they liked the virtual reality intervention and that
they would like to use the equipment again during chemotherapy treatments. Findings support the theoretical premise that distraction mitigates perceptions of symptom distress. This was the first study to suggest that virtual reality as a distraction intervention has positive clinical outcomes.
DEDICATION

This dissertation is dedicated to;

my husband, Kevin, whose love and support have assisted me in seeing my dream realized.

our children, Paul and Kate.

May they always strive for fulfillment of their dreams.
ACKNOWLEDGEMENTS

I am grateful to my dissertation committee members, Dr. JoAnne Youngblut, Dr. Sandra Fulton Picot, and Dr. Karen Olness, who willingly shared their time and expertise. Special thanks to my committee chairperson, Dr. M. Linda Workman for her support and encouragement during my dissertation research and her mentorship throughout my doctoral studies.

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CHAPTER I

BACKGROUND AND SIGNIFICANCE

Introduction

This study tested the premise that virtual reality as a distraction intervention decreased the symptom distress associated with chemotherapy treatments in children aged 10-17. Treatments for cancer are intensive and difficult to endure even for mature adults who have developed effective coping skills. The use of distraction as a coping mechanism for cancer patients is well documented in the literature. Distraction interventions are effective because the individual concentrates on pleasant or interesting stimuli instead of focusing on unpleasant symptoms.

Virtual reality as a distraction intervention is both immersive and interactive. It is a computer simulated technique allowing an individual to hear and feel stimuli that correspond with a visual image. For this study the individual wore a commercially available head set projecting an image with corresponding sounds. The sense of touch was involved through the use of a computer mouse. A synthesis of Lazarus and Folkman's (1984) stress and coping theoretical framework and a model of the self-sustaining process in adolescents (Hinds & Martin, 1988) was used to guide the study.
An interrupted time series design with removed treatment was used to answer the following research questions: 1) Is virtual reality an effective distraction intervention for reducing chemotherapy-related symptom distress in children? and 2) Does virtual reality have a lasting effect? Hypotheses: 1) There will be differences in measures of symptom distress in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments, and 2) There will be differences in measures of symptom distress two days following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

The convenience sample consisted of 12 children receiving outpatient chemotherapy at a clinical cancer center. Data from 11 subjects were used for analysis. The Symptom Distress Scale (McCorkle & Young, 1978) was used to measure chemotherapy related symptom distress and the State-Trait Anxiety Inventory for Children (Speilberger, 1970) was used to measure anxiety. Single item indicators were used to measure the specific symptoms of nausea and vomiting. For each of
three matched chemotherapy treatments, one pre-test and two post-test measures were employed. The hypotheses were tested using repeated measures ANOVA.

Results demonstrated a significant difference ($p < .10$) in scores on the Symptom Distress Scale immediately following the chemotherapy treatment during which the subjects used the virtual reality distraction, as compared with scores obtained during the first and third chemotherapy treatments. State anxiety scores decrease over the three chemotherapy treatments and do not appear to be influenced by the intervention.

Statement of Problem

Although cancer is traditionally thought of as a disease of old age, cancer is a leading cause of death among children and adolescents. In 1997, approximately 8,800 children will be newly diagnosed with cancer in the United States (American Cancer Society, 1997). These children will receive a variety of intensive treatments for this disease including radiation, surgery, and chemotherapy. The expected survival rate for these children as a group is 71% (American Cancer Society, 1997); the chances for survival are enhanced if children can receive all of the recommended chemotherapy treatments for their specific disease. However, because of the associated chemotherapy-related distress
symptoms, some children have difficulty adhering to the prescribed schedule. Thus, helping children to follow the prescribed scheduled treatments is a challenge for health care professionals working with this population.

This study proposed that virtual reality as a distraction method can provide nurses with an intervention that has the potential to alleviate symptoms in this vulnerable population. Support for such an intervention can be found by examining distressful symptoms associated with chemotherapy, distraction as a coping style for children, and the unique features of virtual reality as an intervention for children.

Chemotherapy-Associated Symptoms

Treatments for cancer are intensive and often difficult to endure even for mature adults who have developed effective coping skills. In order to achieve a cure, patients must often tolerate a high level of distress, which is the result of treatment and disease related side effects. Severe side effects include nausea, vomiting, pain, fatigue, and hair loss. Symptom distress is a global concept that encompasses the discomfort experienced from a wide variety of symptoms. McCorkle and Young (1978) include nausea, appetite changes, insomnia, pain, fatigue, bowel pattern changes, difficulty breathing, coughing, changes in appearance,
and changes in concentration as indicators of symptom distress in adult oncology patients. Acute post chemotherapy symptoms such as nausea and vomiting can last for 48 hours (Rhodes, Watson, Johnson, Madsen, & Beck (1987).

Nausea and vomiting are recognized as distressful side effects of chemotherapy. As many as 60% of patients experience these side effects. Coons, Leventhal, Nerenz, Love, & Larson (1987) found that patients who are anxious during the first chemotherapy treatment are more likely to experience anticipatory nausea with subsequent treatments. These investigators also suggest that patients who are younger and those that develop anticipatory nausea are more likely to experience distress with chemotherapy treatments. For some patients antiemetics are effective for treatment of nausea and vomiting. However, antiemetics are associated with many undesirable side effects such as sedation, extra-pyramidal reactions, anxiety, mood changes, and diarrhea. Another major barrier of antiemetic therapy is that most of these drugs are administered intravenously and often require hospitalization (Otto, 1994).

Symptom distress such as nausea, vomiting, fatigue, and anorexia can be a dose limiting effect of chemotherapy treatment. Dose limiting effects of treatments are those symptoms that result in interruptions or
alterations in prescribed chemotherapy regimens. Delays in treatment, dose reductions, and prematurely discontinuing chemotherapy may adversely affect patients' survival (Coons et al., 1987). Researchers report that behavioral interventions such as relaxation, distraction, and guided imagery are coping strategies often helpful in relieving the symptom distress (Otto, 1994).

**Coping in Children**

To consider how children cope with symptoms associated with chemotherapy, it is important to explore the common coping strategies used by healthy children. As children mature, so do their abilities to use coping mechanisms effectively (Hoffner, 1993). Several studies have examined coping patterns in children. Altschuler (1989) and Ross (1984) both identified distraction as a commonly used coping strategy in school age children. Hoffner (1993) found in a sample of elementary age children that the use of distraction techniques for coping increased with age.

Coping is considered a central component of adolescent psychological competence (Groer, Thomas, & Shoffner, 1992). While little research has examined adolescent coping strategies, the available research indicates that adolescents use a variety of coping mechanisms.
Strategies include aggression, self-destruction, stress recognition, endurance and distraction (Dise-Lewis, 1988). Groer et al. (1992) found that distraction is the most commonly used coping strategy for healthy adolescents. The use of distraction techniques as coping mechanisms for adolescents is well established (Dise-Lewis, 1988; Groer et al., 1992). Distraction techniques are also used effectively by children receiving cancer chemotherapy (Tyc, Mulhern, Jayawardene, & Fairclough, 1995).

**Distraction as an Intervention**

The use of distraction as a coping mechanism for cancer patients is well documented. Distraction techniques divert the focus of attention away from unpleasant stimuli. These techniques work by manipulating the environment. Distraction interventions are effective because the individual can concentrate on pleasant or interesting stimuli instead of focusing on unpleasant symptoms (Hockenberry & Bologna-Vaughan, 1985; Gaberson, 1991).

Techniques such as humor, relaxation, music, and imagery are classified as distraction interventions. The use of distraction relieves physical and psychological symptoms. These techniques can relieve symptoms such as pain, anxiety, nausea, and stress. Some institutions are starting to use distraction techniques as part of their routine care.
Hockenberry & Bologna-Vaughan (1985) conducted a survey of Pediatric Oncology Group institutions and found that 20% of institutions use distraction methods when preparing children for bone marrow aspirations and 30% of institutions use distraction when preparing children for lumbar punctures. Hinds and Martin (1988) validated that adolescents with cancer use distraction as a coping mechanism and that the goal of distraction is "to replace disruptive thoughts" (p.338).

While studies show that distraction techniques are helpful to some individuals, they do not work for everyone. Even with practice, some individuals are unable to divert their attention away from unpleasant symptoms enough to allow a distraction intervention to work. Research has linked an individual's ability to use distraction techniques effectively with the person's established coping style (Lerman et al., 1990). These researchers indicate that individuals with a distraction-oriented type coping style report less symptoms than individuals who use an information gathering style of coping. Individual differences may influence the effectiveness of specific distraction techniques. A distraction-oriented coping style is one where the individual attempts to focus on things other than the specific stressor. An example of a person who uses information gathering style is someone who reads literature about an incurable disease. The increased understanding helps the
person to cope. The two coping styles identified in the research by Lerman et al. (1990) are both directed at lessening emotional distress and are therefore consistent with the emotion-focused coping designation proposed by Lazarus and Folkman (1984).

The literature identifies some limitations to the distraction interventions studied to date. It is suggested that active distraction techniques may be more effective than passive distraction techniques (Groer et al., 1992), but this premise has never been tested. Various distraction techniques such as music, humor, relaxation have been tested, but all these interventions require that the person consciously and continuously concentrate on the distraction strategy. Individuals cannot allow competing stimuli from the environment to dominate their awareness. Many distraction interventions such as imagery, and progressive relaxation, require that the patient practice the techniques prior to contact with unpleasant stimuli. Study results do not indicate how long the effects of the distraction interventions last. Finally, coping style may influence one's ability to effectively use the distraction intervention. This study attempted to clarify some of these limitations by using a computer-simulated virtual reality system as a distraction intervention.
Virtual Reality

A report requested by the National Research Council advocates "massive investment" in the field of virtual reality research in order to determine how virtual reality can improve education and health care (The Chronicle of Higher Education, 1994). Computer simulated images, such as video games, can distract children for long periods of time. Computer images are used for recreation, relaxation, or distraction. Virtual reality technology is a computer simulated technique that meets the criterion established by Hinds and Martin (1988) for a distraction intervention. That is, virtual reality diverts the focus of attention away from stressful stimuli. This technology allows an individual to hear and feel stimuli corresponding with a visual image. The individual wears a hood that projects an image with the corresponding sounds. The sense of touch is involved through use of an electronic glove or computer mouse that allows manipulation of the image or transfer of touch sensation. A unique quality of virtual reality as a distraction technique is that it is both immersive and interactive (Arthur, 1992; Pratt, Zyda & Kelleher, 1995).

Examination of virtual reality as a distraction intervention will help to fill some gaps that currently exist in the distraction literature. Virtual reality involves active participation and does not require that the individual practice the technique prior to the stressful situation.
Computers are programmed to produce a variety of images. For example, a virtual reality image may help to create the sensation that the user is by the ocean experiencing the corresponding wave sounds, warm sun, and sea breezes. Another image could be that of a pilot guiding a space ship traveling to Mars. Virtual reality technology may allow researchers to test the effectiveness of different types of images, or to determine whether certain images are more therapeutic for specific age groups.

John Phillips writes in *Nursing Science Quarterly*, "When virtual reality becomes an actuality in health care, nurse researchers will have to evaluate its usefulness for and application to nursing" (1993, p. 5). One potential application of virtual reality is as a distraction intervention. Virtual reality has the potential to help children cope with the distressful symptoms often associated with chemotherapy treatments. Decreasing the level of distressful side effects of chemotherapy improves the child's quality of life while receiving treatments, and increases the chances that they will be able to comply with the prescribed regimen. By attempting to minimize chemotherapy side effects, it is hoped that children can receive the prescribed doses of chemotherapy as scheduled. When children receive their chemotherapy as prescribed, adequate doses are administered at proper intervals to destroy malignant tumors, thus chances for cure are enhanced.
Organizing Framework

This study used a synthesis of Lazarus and Folkman's (1984) stress and coping model and a model on the self-sustaining process developed by Hinds and Martin (1988) as a theoretical framework. Lazarus and Folkman (1984) define coping as the "constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person" (p.141). Coping is viewed as a process involving appraisal of a stressful situation and attempts to manage the stressful situation (Lazarus & Folkman, 1984).

The stress and coping model proposed by Lazarus and Folkman (1984) consists of three major components, stress, appraisal, and coping. Stress is delineated as a relationship between the person and the environment that the person evaluates as taxing or exceeding their available resources and threatening their well-being. Cognitive appraisal is the process a person uses to determine if they are faced with a stressful situation. Cognitive appraisal can be characterized as the process of "categorizing an encounter, and its various facets, with respect to its significance for well-being" (Lazarus & Folkman, 1984, p. 31). Two types of appraisal are specified primary and secondary appraisal. In primary appraisal, the person evaluates the effect of an
encounter with the environment on their well-being. Secondary appraisal consists of an evaluation of what resources may be utilized to manage the stressful situation.

Coping responses reflect the various thoughts and activities people use to manage stressful situations (Lazarus & Folkman, 1984). Lazarus and Folkman (1984) theorize that two types of strategies with distinct coping functions exist: those directed at (a) managing or altering the problem, or problem-focused coping, and (b) regulating the emotional response to the problem, or emotion-focused coping (Hinds & Martin, 1988). Lazarus and Folkman (1984) state that individuals turn to emotion-focused coping when they perceive that nothing can be done to change the threatening condition. Distraction meets this criterion for an emotion-focused coping strategy.

Reappraisal is the continuous evaluation of the potential threat to well-being that results from the person-environment relationship (Lazarus & Folkman, 1984). As coping responses are initiated to manage the stressful situation, the person assesses the effectiveness of the strategies and reevaluates the potential threat to well-being. Thus, the appraisal and coping responses are viewed as part of a continuous and simultaneous process to manage a stressful situation.

In 1988, Hinds and Martin extended Lazarus and Folkman’s (1984)
work in a theory generating study. They used grounded theory methods to postulate that adolescents, ages 12 to 18, with cancer progress sequentially through four phases of a self-sustaining process. The self-sustaining process is a description of how adolescent coping develops in the face of a serious health threat (Hinds & Martin, 1988). Hinds and Martin's (1988) model of the self-sustaining process in adolescents with cancer is presented in figure 1. The four phases of the self-sustaining process are described below.

Figure 1

SELF-SUSTAINING PROCESS

Cognitive Discomfort + Distraction + Cognitive Comfort + Personal Competence
\[ \rightarrow \]
Adaptation to Symptoms
\[ \rightarrow \]
Commitment to Treatment
\[ \rightarrow \]
Taking Care of Problems

The first phase adolescents with cancer experience is cognitive discomfort. In this phase the individual has an awareness of negative thoughts about their illness. There is a sense of uneasiness that the adolescent feels a need to relieve.

The second phase is that of *distraction*. Hinds and Martin (1988) define distraction as "the extent to which the adolescent practices cognitive/behavioral activities that promote concentration on neutral or positive thought and conditions" (p. 337). In this phase, the goal is to remove negative thoughts from conscious awareness. The strategies of the distraction phase are considered emotion-focused coping and represent the adolescent’s efforts to alter their perception of the cancer experience rather than the disease itself (Hinds & Martin, 1988). Some examples of distraction techniques are doing something, physical activity, and reading.

The third phase of the self-sustaining process is *cognitive comfort*. This is a desired state and is characterized by lifting of spirits and periods of solace. An internal equilibrium is achieved. Feelings of hopefulness and forgetting cancer are characteristic of this phase (Hinds & Martin, 1988).

*Personal competence*, is the fourth and final phase. It is described as the extent to which the "adolescents perceive themselves to be
resilient, resourceful, and adaptable in the face of serious health threats."
(Hinds & Martin, 1988, p. 339). Three strategies are identified as part of
personal competence: commitment to treatment, taking care of problems,
and adaptation to symptoms. These strategies allow for a type of
transcendence over the health threat. Adaptation to symptoms is
described as the degree to which the adolescent perceives discomfort
from disease or treatment-related side effects. In the study by Hinds &
Martin (1988), the adolescents share a dislike for the side effects of
therapy, particularly the loss of hair, nausea, and vomiting, but describe a
kind of adaptation to side effects that made them more tolerable.

Lazarus and Folkman (1984) delineated two separate coping
strategies for facing times of distress. The model by Hinds and Martin
(1988) provided a description of how adolescent coping develops in the
face of a serious health threat. In both models distraction techniques
were considered a type of emotion-focused coping. Both models
suggested that distraction techniques mitigate the perceptions of
symptoms distress. This study tested the premise that virtual reality as a
distraction intervention decreases the symptom distress associated with
chemotherapy treatments in older children.
Purpose

The purpose of this study was to examine the effects of a Virtual Reality distraction intervention on symptom distress levels in children with cancer. An interrupted time series design with removed treatment was used to test the hypothesis: There will be differences in measures of symptom distress in a single group of children with cancer who receive a virtual reality distraction intervention during their second chemotherapy treatment and who receive no virtual reality intervention during their first and third chemotherapy treatments.

There were several unique features of this study. The effectiveness of a developmentally specific distraction technique was tested with children. Several post treatment measures of symptoms distress levels were obtained and an attempt was made to learn whether this distraction intervention had a lasting effect. This study used a distraction intervention that did not need to be practiced. Virtual reality was immersive and capable of blocking sensations from competing environmental stimuli.

Research Questions & Hypotheses

Q(1) Will general symptom distress levels be lower in children with cancer who receive a virtual reality distraction intervention during a
chemotherapy treatment as compared with symptom distress levels in the same children during the chemotherapy treatment prior to, and following the use of the virtual reality distraction intervention?

H (1) There will be differences in measures of symptom distress immediately following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

Q(2) Does the virtual reality intervention have a lasting effect on children that is capable of mitigating chemotherapy-related symptoms over time?

H (2) There will be differences in measures of symptom distress two days following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

Major Study Variables

Independent Variable: Virtual Reality

Virtual reality is defined as a distraction technique. Virtual Reality
meets the criteria for a distraction intervention because it diverts the focus of attention away from the stressful stimuli (Hockenberry & Bologna-Vaughan, 1985; Gaberson, 1991). Physically described, it is a computer simulated technique that allows an individual to hear and feel stimuli corresponding with a visual image. The individual wears a head set which projects an image with the corresponding sounds. The sense of touch is involved through use of a computer mouse that allows manipulation of the image or transfer of touch sensation. Study participants used the virtual reality headset during one of their intravenous chemotherapy treatments. Steuer (1992) advocates use of an experience driven definition based on the concepts of presence, which is viewed as being in an environment, and telepresence, which is the "experience of presence in an environment by means of a communication medium" (p. 76). Combining these experience related concepts, Steuer defines virtual reality as "a real or simulated environment in which a perceiver experiences telepresence" (Steuer, 1992, pp. 76-77).

**Dependent Variable: Symptom Distress**

Symptom distress is defined as the symptoms experienced by the cancer patient. Symptom distress was measured at nine time points using the Symptom Distress Scale (McCorkle, & Young, 1978) as a
general indicator. Specific indicators of symptom distress used included the State-Trait Anxiety Inventory for Children (STAIC C-1) (Speilberger, 1970), and single item indicators for nausea and vomiting.

Using a broad outcome indicator such as general symptom distress was beneficial because virtual reality had not yet been tested as a distraction intervention. By measuring general symptom distress it was possible to look for overall effects as well as effects associated with each specific subscale. The STAIC C-1 and single item indicators tested outcomes for specific symptoms such as nausea, vomiting or anxiety.

Relationship Among Variables

The relationships between constructs, concepts, and empirical measures for each variable are represented in Figure 2.

Figure 2

Relationship Between Constructs, Concepts, and Empirical Indicators

<table>
<thead>
<tr>
<th>Construct</th>
<th>Concept</th>
<th>Empirical Indicators</th>
<th>Distraction</th>
<th>Virtual Reality</th>
<th>Participation in Virtual Reality during therapy</th>
<th>Adaptation to Symptoms</th>
<th>Symptom Distress Levels</th>
<th>Symptom Distress Scale</th>
<th>STAIC C-1</th>
<th>Single item indicators for nausea and vomiting</th>
</tr>
</thead>
</table>
Significance to Nursing

The use of distraction techniques as mechanisms for coping in cancer patients is well documented in the literature. Coping is a phenomenon of concern for nursing. In fact, the North American Nursing Diagnosis Association has established ineffective coping as a nursing diagnosis (Carpenito, 1992). One focus of nurses is helping individuals to cope with actual or potential distress. One way to do this is by manipulation of the environment (Hockenberry & Bologna-Vaughan, 1985; Gaberson, 1991). Distraction techniques manipulate the environment by diverting the focus of attention away from side effects.

Historically, Florence Nightingale recognized the importance of controlling the environment to promote healing. While Nightingale is best known for her work with improving hygienic conditions in the living quarters of soldiers, she also recognized the importance of recreation and established the first hospital recreation centers on army posts. She believed that providing a pleasant environment could enhance healing (Schuyler, 1992).

This study adds to nursing knowledge development by including all of the metaparadigm concepts for nursing; man, health, nursing, and environment. The concept of health is represented by levels of symptom distress. The concept of man is represented by children with cancer.
The study participants are exposed to a nursing intervention that manipulates perceptions of the environment.

The 1994 Oncology Nursing Society Research Priorities lists quality of life and symptom management as the high priority items for cancer nursing research (Stetz, Haberman, Holcombe, & Jones, 1994). These research priorities are consistent with the directions for nursing research recommended by the National Center for Nursing Research (1993) and the American Nurses Association Cabinet on Nursing Research (1985). This study has the potential to improve patient quality of life by testing the effectiveness of a symptom management intervention. The top research priorities identified by the Oncology Nursing Society have been incorporated into this research study.

Conducting this study tested the effectiveness of a specific distraction intervention and contributed to a body of knowledge that would help nurses predict whether a given distraction intervention is appropriate for managing distressful symptoms in a specific population. Knowing how best to assist individuals to cope with the side effects of chemotherapy treatment makes it easier for individuals to tolerate treatments, improves quality of life, and enhances the chances for cure.
CHAPTER II
LITERATURE REVIEW

Introduction

This chapter reviews literature related to the study variables. The concept of chemotherapy-related symptom distress is presented, including related research studies and instruments used to measure this concept. Literature related to distraction as a nursing intervention is reviewed and the appropriateness of virtual reality as a distraction intervention discussed.

Chemotherapy-Related Symptom Distress

Patients with cancer, who are receiving chemotherapy treatments, frequently experience severe symptom distress. McCorkle (1987) defines symptom distress as the "person's level of distress from a specific symptom being experienced" (p. 248). Symptom distress interferes with a person’s ability to perform activities of daily living and affects quality of life (Ehlke, 1988; Pickett, 1991). The most frequently reported symptoms associated with cancer chemotherapy are nausea and vomiting (Coons et al., 1987; Pickett, 1991; Watson & Marvell, 1992). Other common physical symptoms include anorexia, fatigue, and weight loss (Sarna, Lindsey, Dean, Brecht & McCorkle, 1993; Watson & Marvell, 1992). Patients frequently experience changes in mental state, which are
manifested as feelings of depression, helplessness, anxiety, difficulty concentrating, and changes in outlook (Coons et al., 1987; Munkres, Oberst, & Hughes, 1992, Watson & Marvell, 1992).

Adherence to prescribed chemotherapy treatments is extremely important. Decreased dosages or interruption in treatments can diminish chances for long-term remission or cure (Watson & Marvell, 1992). Symptom distress is a major reason why cancer patients discontinue treatments prematurely (Watson & Marvell, 1992). As a result, management of chemotherapy side effects is a priority for oncology nursing and a major focus for oncology nursing research (Stetz et al., 1991). Nursing interventions designed to manage chemotherapy-related symptom distress can help to improve patient quality of life and enhance chances for cure.

The following section of this review of literature examines the scope of the problem of chemotherapy-related symptom distress in patients with cancer. Several research studies are reviewed. Methods of measuring symptom distress are discussed.

Research Studies

Munkres et al. (1992) conducted an exploratory study of 60 cancer patients. The purposes of this study included describing perceptions of
symptom distress in adult patients undergoing chemotherapy. The researchers also compared symptom distress levels between patients who were treated for new verses recurrent cancer. Symptom distress was measured using a modified version of the Symptom Distress Scale (SDS). Patients in the initial chemotherapy treatment group identified fatigue, loss of strength, sleep disruption, and appearance changes as items which resulted in the most symptom distress. Overall symptom distress scores for the group with recurrent cancer were significantly higher. Items that caused the most symptom distress for this group included fatigue, loss of strength, sleep disruption, discomfort, bowel pattern changes, and nausea (Munkres et al., 1992).

Munkres et al. (1992) also obtained mood scores for both groups. Overall mood scores were low and no differences were found between groups. Regression analysis was performed to identify factors that predict symptom distress. Symptom control and disease recurrence predicted 21% of the symptom distress variance (Munkres et al., 1992). This study provided a good overview of types of symptom distress experienced by patients receiving chemotherapy. No attempts were made to control for type of cancer, stage of disease, or previous treatment.

Ehlke (1988) conducted a study to determine the variables were related to symptom distress in breast cancer patients receiving
chemotherapy treatments. A convenience sample of 107 women completed three instruments and a demographic data sheet. The subjects completed measures of locus of control, social support, and the SDS. Information of stage of cancer and types of treatment were obtained from the patient charts. Significant positive correlations were found between symptom distress and the independent variables: chance external health locus of control and perception of illness. A significant inverse relationship was found between internal locus of control and symptom distress (Ehlke, 1988).

Symptom distress levels for this sample were low, with fatigue, pain, appetite, and coughing being the major causes of symptom distress. Stage of cancer or severity of treatment were not significantly correlated with symptom distress. It is interesting to note that nausea and vomiting were not reported as major sources of symptom distress in this sample. The researcher stated that one of the limitations of this study was that it did not control for use of antiemetics (Ehlke, 1988).

Sarna et al. (1993) conducted a longitudinal study examining nutritional intake, weight change, and symptom distress over a six month period in a sample of adult patients with lung cancer. Data were collected at 5 six week intervals over 6 months. Data from 28 subjects were collected at time one, and due to the frail population, only nine subjects
participated in the final data collection. The small sample size limited the ability of statistical tests to find significant findings. No attempts were made to control for the proximity of cancer treatments to the data collection points. Despite the limitations, a few general findings could be inferred from this study. Symptom distress and specific symptoms of hunger, nausea, and appetite changes demonstrated slight fluctuations over time. Symptom distress was not correlated with decreased nutritional intake (Sarna et al., 1993).

While the previous two studies explored symptom distress in patients with a specific type of cancer, a study by Holmes (1991) attempted to delineate the incidence of symptom distress in patients receiving two different types of treatment for cancer. Findings from this study of 22 patients receiving chemotherapy and 29 patients receiving radiation therapy indicated that overall symptom distress levels as measured by the SDS were similar in the two groups (Holmes, 1991). Differences in specific symptoms existed between the two groups. A common complaint for both groups was tiredness, which correlated with measures of concentration and mood. Patients receiving radiation experienced significant distress as a result of pain, appearance changes, constipation, and appetite changes. In patients receiving chemotherapy, symptoms which related to the overall SDS score included nausea,
appetite changes, sleep disturbance, mobility, tiredness, ability to concentrate, mood changes and appearance (Holmes, 1991). A limitation of this study, like others reviewed thus far, was that the report did not indicate when the SDS was administered in relation to the administration of cancer treatment.

A second purpose of this study by Holmes (1991) was to evaluate the SDS. The researcher reported that the instrument was easily completed in 8-10 minutes and that the reliability was high for both groups. The Coefficient alpha for the chemotherapy group was .91 and for the radiation group was .94 (Holmes, 1991). Holmes (1991) reported that the instrument can differentiate between areas of greater and lesser concern for individual patients. Patient responses were validated, when possible, by referring to medical and nursing records. Holmes (1991) suggested that the SDS is useful for the assessment of individual patients and may "provide a means by which the effects of interventions, designed to alleviate physical distress, could be evaluated" (p.439).

The previous studies demonstrated that symptom distress is a common phenomenon among adult cancer patients receiving chemotherapy. A variety of specific symptoms were included under the general term symptom distress. Research which characterized the patterns of symptom distress focused generally on the specific symptoms of nausea
and vomiting. The following section identifies specific factors associated with the symptoms of nausea and vomiting.

Using a cross-sectional design, Coons et al. (1987) conducted interviews of 34 patients who received cisplatin-based chemotherapy for treatment of cancer. All patients experienced nausea or vomiting following their most recent chemotherapy treatment. Sixty-four percent of patients exhibited symptoms within two hours (Coons et al., 1987). Anticipatory nausea prior to at least one chemotherapy treatment was experienced by 65% of the sample. While anticipatory nausea was significantly more common among individuals who had received prior chemotherapy, in this sample 54% of patients experienced anticipatory nausea before their first treatment. Anticipatory nausea was found to be related to number of chemotherapy treatments, with 70% of individuals who had completed five or more treatments experiencing this symptom (Coons et al., 1987). Other factors associated with anticipatory nausea included anxiety and age. Patients who were younger than 55 and who were anxious prior to their first chemotherapy injection reported higher levels of anticipatory nausea. An important finding from this study was the high incidence of reported symptoms, probably related to treatment with cisplatin, a highly emetogenic agent.

A multiinstitutional, time series study conducted by Rhodes et al
documented patterns of post-chemotherapy symptoms among 309 adult patients. Measures of nausea, vomiting, symptom occurrence, and symptom distress were obtained at 12, 24, 36, and 48 hours post chemotherapy treatment. An adapted version of the SDS was used for this study. The scale was expanded to 16 items and some of the language changed in order to more specifically measure the symptoms of nausea and vomiting (Rhodes, Watson, & Johnson, 1984). Seventy one percent of patients experienced little or no nausea during the immediate 48 hours post chemotherapy. For 84% of individuals, vomiting was well controlled within the first 48 hours after treatment (Rhodes et al., 1987).

For the remaining individuals (approximately 25% of the sample) who experienced more severe symptoms, distinct patterns emerged for each of the measures obtained. Some subjects experienced a peak of nausea or vomiting at the 24 hour measure post treatment. Other subjects exhibited a declining pattern, where vomiting and symptom occurrence gradually decreased over the 48 hour period following chemotherapy treatment. Mean total scores for nausea, vomiting, and retching were highest the morning following chemotherapy and gradually declined over the next 24 hours (Rhodes et al., 1987). This study suggested that, for a majority of subjects, the first 48 hours post chemotherapy treatment was the time period when symptom occurrence and symptom distress was the
highest. A limitation of the study was that the post-chemotherapy measures were not obtained beyond 48 hours, although graphic representations of symptom occurrence and symptom distress suggested a trajectory toward improvement.

Pickett (1991) conducted a study of 60 adults patients with cancer who were receiving an initial course of chemotherapy treatment. Prior to the first chemotherapy administration, measures for several variables hypothesized to influence anticipatory nausea were obtained. Variables measured included symptom distress, mood disturbance, emetic potential of chemotherapeutic agents, stage of cancer, sensitivity to conditioning cues, psychosocial stress, age, and ability to cope. Subjects were followed during subsequent cycles of chemotherapy treatment. Thirty two percent of subjects developed anticipatory nausea, while none of the subjects developed anticipatory vomiting (Pickett, 1991).

A univariate analysis illustrated that subjects, who developed anticipatory nausea, differed significantly from those of subjects who did not develop this symptom (Pickett, 1991). Subjects who developed anticipatory nausea had an earlier stage of cancer, were younger, and received chemotherapeutic agents with a higher emetogenic potential (Pickett, 1991). A combination of variables accurately predicted anticipatory nausea in 100% of the patients who experienced anticipatory
nausea. A prediction equation including the variables of symptom distress level, emetic potential of chemotherapy, mood disturbance, psychosocial distress, and ability to cope, accounted for 53% of the variance (Pickett, 1991). The tendency for younger patients treated with chemotherapy to experience higher levels of nausea and vomiting was confirmed in a study by Dodd, Onishi, Dibble, and Larson (1996). This study explored levels of nausea, vomiting and retching in 128 patients from four different outpatient sites. While differences were not statistically significant, younger patients (< 65 years) consistently scored higher over a four month period on measures of nausea, vomiting and retching.

A limited number of researchers have explored the topic of symptom distress in children with cancer. Kuttner, Bowman, and Teasdale (1988) compared the efficacy of a hypnotic procedure, a behavioral distraction, and standard medical practice on the reduction of pain, anxiety and distress in children, during bone marrow aspirations. Forty eight children were included in the sample. Children were divided into two groups, younger children ages 3 to 6 and older children ages 7 to 10 children. Subjects were then randomly assigned to one of the three intervention groups. An observational instrument, the Procedure Behavior Rating Scale (Katz, Kellerman, & Siegel, 1980) was used to measure distress (Kuttner et al., 1988).
Results indicated a significant decrease in distress in the younger group who used hypnosis. The older children in both the distraction and the hypnosis group demonstrated a significant decrease in pain and anxiety, but not in distress (Kuttner et al., 1988). Post-hoc analysis indicated that distraction was significantly more beneficial in controlling pain for older children (Kuttner et al., 1988). In the discussion, the authors hypothesize that the use of distraction interventions may be more developmentally appropriate for school age children, because as they mature, they are more able to assume some responsibility for the process of coping (Kuttner et al., 1988).

Enskar, Carlsson, Golsater, and Hamrin (1997) conducted qualitative interviews with ten Swedish adolescents who had been treated for cancer between the ages of 13 and 20. The two major domains explored in the interviews were problems due to the disease and areas of life that had been affected by cancer. The adolescents identified physical side effects of the treatment as the worst aspect of the disease. Symptoms such as vomiting, anorexia, and changes in appearance were distressing. The cancer experience negatively influenced the ability of the adolescents to establish their identities, a major developmental task for this age group (Enskar et al., 1997).

In summary, the studies reviewed indicated that symptom distress
was a problem for patients receiving chemotherapy (Coons et al., 1987; Munkres et al., 1992; Enskar et al., 1997). Patients exhibited symptom distress regardless of type of cancer (Ehlke, 1988; Sarna et al., 1993). Symptom distress was associated with age. Younger patients with cancer, whether adults or children exhibited higher levels of symptom distress (Coons et al., 1987; Kuttner et al., 1988; Pickett, 1991; Watson & Marvell, 1992; Dodd et al., 1996). Peak symptom distress, specifically symptoms of nausea and vomiting, occurred within 48 hours of chemotherapy treatment (Coons et al., 1987; Pickett, 1991; Rhodes et al., 1987). The emetic potential of the chemotherapeutic agents was associated with higher anticipatory nausea and symptom distress in cancer patients (Coons et al., 1987; Pickett, 1991). Finally, anxiety, and mood disturbance could be linked to symptom distress (Holmes, 1991; Munkres et al., 1992; Pickett, 1991).

The broad concept of symptom distress was chosen for this study for several reasons. Since virtual reality as a distraction intervention has not been clinically tested, it is difficult to predict exactly which symptoms this intervention may alleviate. An instrument measuring the occurrence of specific symptoms and providing and overall score of symptom distress is ideal for determining the effectiveness of this intervention. Research indicates that a variety of factors influence the occurrence of specific
symptoms in patients with cancer. Some populations experience more nausea (Coons et al., 1987), while others complain of intense fatigue (Munkres et al., 1992; Sarna et al., 1993). Using a global indicator of symptom distress improves the chances of capturing an effect within a sample of children with a wide variety of cancer diagnoses.

Pickett (1991) emphasizes that "persons receiving a protocol of chemotherapy may choose to discontinue treatment based on their inability to tolerate the side effects of antineoplastic agents" (p. 335). Major challenges for oncology nursing are finding and evaluating interventions that alleviate symptom distress in cancer patients receiving chemotherapy. Such interventions could increase the patient compliance with the treatment regimen and thus, potentially have an impact on overall survival as well as quality of life during the cancer experience.

**Measurement of Symptom Distress**

McCorkle (1987) identifies three reasons to measure symptom distress; "1) to aide patients in monitoring their level of health, distress, or progress; 2) to determine patients' needs and problems; and 3) to determine the effectiveness of various modes of treatment and care" (p. 248). Measuring symptom distress in this study helped to evaluate the effectiveness of a virtual reality distraction intervention. Several different
instruments are available to measure symptom distress. The next portion of the literature review discusses some of these instruments and presents rationale for why the Symptom Distress Scale (McCorkle & Young, 1978) was chosen for this study.

Instruments commonly used to measures of symptom distress in cancer patients include the Hopkins Symptom Checklist (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974), the Symptom Checklist-90-R (Kiger & Murphy, 1987), the Procedure Behavior Rating Scale (Katz et al., 1980), and the Symptom Distress Scale, (McCorkle & Young, 1978). Only instruments with reported reliability and validity were considered.

One of the original instruments developed to measure symptom distress was the Hopkins Symptom Checklist (HSCL) (Derogatis, et al., 1974). This 58 item instrument uses a four point Likert format, and was originally developed as measure of symptoms in adult psychiatric populations. Five underlying symptom dimensions are represented in the overall score: anxiety, depression, somatization, obsessive-compulsive, and interpersonal sensitivity. The instrument requires approximately 30 minutes to complete. Reliability and validity for the instrument are well established. Coefficient alpha measures of internal consistency for the subscales ranged between .84 and .87, based on N = 1435 of combined adult samples. Test-retest reliability for the same sample ranged from .75 to .82.
(Derogatis et al., 1974). Derogatis et al. (1974) claim that convergent validity has been demonstrated in psychiatric populations and cite numerous studies to support this claim.

The Symptom Checklist-90-R (SCL-90-R) (Kiger & Murphy, 1987), is an adaptation of the HSCL. This instrument is a 90 item self-report symptom inventory that takes 15-20 minutes to complete. It is a 5 point Likert-type scale and consists of subscales for nine symptom dimensions. The dimensions included in the HSCL as well as hostility, phobic anxiety, and paranoid ideation, are incorporated into the SCL-90-R. This instrument is also used primarily to measure psychologic distress. In a control group and a sample of bereaved adults, the range of coefficient alpha estimates for all subscales was .67 to .91. Indicators of reliability and validity for this instrument with other samples have been excellent (Kiger & Murphy, 1987).

Neither the HSCL or the SCL-90-R was chosen for this study for several reasons: 1) the instruments primarily measure psychologic distress and have been tested on adult psychiatric populations, 2) reliability and validity information for either instrument could not be found for a pediatric sample, and 3) the language of the instruments and time required for completion make them less than ideal for use with a sample of children.

The Procedure Behavior Rating Scale (PBRS) (Katz et al., 1980) was
developed primarily for use in children undergoing medical procedures. This scale consists of 25 operationalized defined behaviors, which are rated by an observer during a procedure such as a bone marrow aspiration. The observer indicates the presence or absence of each behavior. The PBRS has demonstrated acceptable reliability and validity scores, but critics suggest that it measures the variety of distress behaviors rather than the intensity of distress (Noelker & Peterman, 1990). This instrument was not chosen for the proposed study because of the researcher’s bias that symptom distress is perceived by the individual and is best measured by the individual experiencing the distress. Also, while this instrument may have been useful for measuring distress during the chemotherapy treatment, it would not be appropriate for measuring distress levels following the conclusion of a chemotherapy treatment.

The Symptom Distress Scale (SDS) (McCorkle & Young, 1978) is a general indicator of symptoms experienced by the cancer patients. The instrument is a 13 item scale measuring a variety of physical and psychological symptoms. The severity of each symptom is rated on a 5 point Likert-type scale with a rating of one indicating absence of distress and a rating of 5 indicating extreme distress. Total scores range from 13-65 and are obtained by adding the scores obtained for each of the scale items. The scale takes 5-10 minutes to administer.
The instrument was developed to identify concerns of patients receiving chemotherapy treatments. The reliability and validity of this instrument are well established (McCorkle, 1987). The tool has demonstrated construct and content validity for specific symptoms. A correlation of .90 between SDS score and scores on the Ware's health perception questionnaire demonstrates convergent validity (McCorkle, 1987). The reliability coefficient alpha has been reported at values between 0.79 and 0.89 in numerous samples of adult cancer patients (McCorkle, 1987). The scale discriminates between heart patient survivors and cancer patients (McCorkle, & Quint-Benoliel, 1983) as well as between home care patients and controls (McCorkle, 1987).

The instrument was chosen because it can measure changes in symptoms distress within a single individual over time (Hinds, Quargnenti, & Wentz, 1992; McCorkle, 1987). The scale has been used without modifications in studies of children with cancer by Haase (personal communication, 1/1994), and in adolescents with cancer (Hinds et al., 1992). Hinds et al. (1992) reported internal consistency levels of .82 and .85 with two samples of adolescent cancer patients. Reliability testing for Haase's population of adolescents resulted in a coefficient alpha of .91 (personal communication, J. Haase, 3/1994).

This instrument has been used extensively to measure symptom
distress in a variety of cancer populations. The majority of studies presented earlier used the SDS successfully to measure symptom distress (Ehike, 1988; Holmes, 1991; Munkres et al., 1992; Sarna et al., 1993). The SDS was chosen for this study because of excellent psychometric properties and a demonstrated sensitivity to measuring the concept of symptom distress in children.

The above review confirmed that chemotherapy-related symptom distress is a problem that requires nursing intervention. A review of the available instruments to measure symptom distress clearly indicated that the SDS is the most appropriate instrument for use in the proposed study. The following section presents literature related to the concept of distraction.

**Distraction**

Relief from an anxiety producing situation can be temporarily or partially obtained by diverting one’s thoughts from the current situation. By focusing on alternative stimuli the individual can the block the sensations occurring as a result of an anxiety producing situation. Distraction occurs frequently in everyday life. Everyone can recall situations when they were frustrated by a difficult task or painful headache. The stress may have been temporarily alleviated by a phone
call from a friend or by watching a favorite television show.

Distraction involves active participation (Smith, Airey, & Salmond, 1990). The person must be able to redirect their focus of attention away from a stressful situation. This process involves the capacity to interpret unpleasant stimuli and to change thoughts. McCaffery (1990) describes distraction as placing an unpleasant sensation in the periphery of awareness. Potential benefits of distraction are enhanced coping, relaxation, and amusement. The remainder of this review presents the research literature which discusses distraction as an intervention and will discuss virtual reality as a distraction technique that merits validation through nursing research.

**Historical Overview**

The potential therapeutic value of distraction was recognized as early as 1507 when studies indicated that soothing music decreased pain sensations (Hockenberry & Bologna-Vaughan, 1985). In his classic review of literature, *The Powerful Placebo*, Beecher (1955) reviewed sixteen studies which all supported the proposition that physical symptoms could be influenced by both medication and psychological factors. Anecdotal and historical accounts verified that the phenomenon of distraction has therapeutic value.
In the 1960s, literature demonstrated that family members, as well as patients, used distraction as a coping mechanism. Chadoff, Friedman, & Hamburg (1964) published a report of parental coping styles based on observations over two years of 46 parents of children with cancer. These authors indicated that distraction and focusing on other responsibilities helped to protect parents from disruptive levels of anxiety. Attempts were made to provide a theoretical explanation for the use of distraction therapies. Since the majority of studies focused on the pain management of patients during painful procedures and during labor, a commonly identified theoretical framework was Melzack and Wall's Gate Control Theory of Pain (1965). In this theory, distraction was thought to interfere with interpretation of the pain sensation by providing a competing stimuli.

In the 1970s, studies continued to test interventions to relieve the dependent variable of pain. Few studies were conducted by nurses, the majority were done by sociologists or psychologists. Imagery and relaxation were the major distraction interventions. Some sample studies included Systemic relaxation to reduce preoperative stress (Aiken, 1972), Relaxation technique to increase comfort level in postoperative patients (Flaherty & Fitzpatrick, 1978), and Role of attentional focus in pain perception: manipulation of response to noxious stimulation by instruction (Blitz & Dinrstein, 1971). Research from the 1970's began to raise
some of the following questions. Was imagery a type of distraction or something completely different? Would distraction interventions work for symptoms other than pain?

The early 1980s brought many studies that attempted to address the questions raised in the previous decade. A substantial number of studies were conducted by nurses. A wide variety of distraction interventions were examined. Common independent variables were music therapy, art therapy, humor, audiotapes (Cogan, Cogan, Waltz & McCue, 1987), as well as imagery and relaxation (Levin, Malloy, & Hyman, 1987). Dependent variables also varied. The effects of distraction interventions on anxiety, feared events (Miller, 1987), painful procedures (Cogan et al., 1987; Levin et al., 1987; Marino, Gwynn, & Spanos, 1989;), and childhood stress (Altshuler, 1989; Hinds & Martin, 1988), were explored. Generally the studies found that the various distraction techniques produced a significant change in the dependent variable. Coping theories, such as Lazarus and Folkman’s (1984) stress and coping theoretical framework and Pearlin and Schooler’s (1978) *The structure of coping*, were more frequently cited than pain control theories.

As qualitative studies became more accepted, a variety of nurse conducted qualitative studies emerged in the late 1980s. Hinds and Martin (1988) used the grounded theory method to study 58 adolescent oncology
patients. They identified distraction as a major coping mechanism used by adolescents. One important aspect of this study was that the authors provided a clear definition of distraction. "The extent to which the adolescent practices cognitive/behavioral activities that promote concentration on neutral or positive thoughts or conditions" (Hinds & Martin, 1988, p.337). Hockenberry and Bologna-Vaughan stated that "it is the use of one's imagination, rather than focusing on external stimuli, which differentiates imagery from distraction" (1985, p.100). In 1993, Mobily, Herr, & Kelly conducted a two round Delphi survey of 42 nurse researchers to validate definitions of cognitive-behavioral techniques to reduce pain. This study conceptually distinguished the definitions for imagery and distraction and supported the above statement that imagery involves the use of imagination. Distraction was defined as the "purposeful focusing of attention away from undesirable sensations" (Mobily et al., 1993, p. 542). Simple guided imagery is defined as "the purposeful use of imagination to achieve relaxation and/or direct attention away from undesirable sensations" (Mobily et al., 1993, p. 542).

The nursing research of the 1990s continued to test the effectiveness of individual distraction interventions as well as to compare the effectiveness of two or more interventions (Gaberson, 1991 & 1995). Some researchers also attempted to combine interventions (Broome, Lillis,
McGahee, & Bates, 1992). Active distraction interventions such as blowing bubbles, or using a kaleidoscope were found to be effective for children receiving painful procedures (French, Painter, & Coury, 1994; Vessey, Carlson, & McGill, 1994). One study linked the effectiveness of a distraction intervention to coping style in adults (Lerman et al., 1990). Individuals who use a distraction-oriented coping style reported fewer symptoms than individuals who tended to use information gathering as a coping style. This study, discussed in more detail later, was the first study to suggest that individual factors may influence the effectiveness of distraction intervention.

In recent years, a consensus has developed among researchers that distraction interventions are useful for nursing practice. Studies suggest that distraction interventions may not be universally effective and may need to be individualized based on factors such as age or coping style (Caudell, 1996). In general, distraction interventions cause no adverse effects (Brennan, 1994). Many authors comment that these interventions may be difficult to implement due to cost restraints, or lack of nursing time. A survey of 54 pediatric nurses confirmed this, and found that often nursed lacked distraction materials or knowledge of how to use distraction interventions (Pederson & Harbaugh, 1995). A challenge for the next decade is to develop an assortment scientifically validated distraction
interventions that are developmentally appropriate for a variety clinical situations.

In summary, over the years an understanding of the concept of distraction has developed. Research for the past three decades has lent empirical support for the anecdotal and historical reports that first identified the therapeutic value of distraction. Distraction can be characterized as a way of coping with stressful events. Distraction interventions are distinct from imagery, and are effective in managing a variety of symptoms.

**Theoretical Frameworks**

Consensus has not been reached on a specific definition for distraction, although the majority of definitions included active participation as a necessary component, and all the definitions indicated that distraction involved a refocusing of attention. Briebart (1989) discussed the control over the focus of attention. Hinds and Martin (1988) referred to distraction as cognitive or behavioral activities to promote concentration on neutral or positive thoughts. Smith et al. (1990) stated that "distraction from pain may be defined as focusing attention on stimuli other than the pain sensation" (p. 30). For the purposes of this study, distraction will be defined as an intervention that focuses attention away from stressful
stimuli to promote concentration on neutral or positive stimuli in the external environment.

In the studies reviewed, distraction was considered either a type of coping mechanism or a nonanalgesic method of pain control. Lazarus and Folkman's (1984) stress and coping theoretical framework was identified in six studies (Ali & Khalil, 1991; Broome, Bates, Lillis, & McGahee, 1990; Carrieri, Kieckhefer, Janson-Bjerklie, & Souza, 1991; Hinds & Martin, 1988; Hoffner, 1993; Mahon, 1991). Hinds and Martin (1988) emphasize that distraction corresponds with the process definition of coping put forth by Lazarus and Folkman (1984). A synthesis of Lazarus and Folkman's (1984) stress and coping theory and the self-sustaining model proposed by Hinds and Martin (1988) was used for the study. The theoretical framework used for this study was presented in detail in Chapter one.

Another frequently cited theoretical framework was Melzack and Wall's Gate Control Theory of Pain (1965). Six articles referenced this work (Barbour, McGuire, & Kirchoff, 1986; Donovan, 1985; Flaherty, & Fitzpatrick, 1978; Levin et al., 1987; Pederson, 1995; Ross, 1984). In this theory, distraction interfered with interpretation of the pain sensation by providing a competing stimulus. Distraction interventions worked by closing the "gate" to the transmission of unpleasant pain stimuli to the sensory and affective centers of the brain. The gate control theory of pain
is a well supported theoretical framework and is appropriate for use with the concept of distraction. The current study explored the effects of a distraction intervention on the broad dependent variable of symptom distress. The specificity of the gate control theory to explaining pain made it inappropriate for use with the proposed study.

Other theoretical frameworks mentioned in the distraction literature were Roy’s (1984) adaptation model cited in Gaberson (1991 & 1995), and Pearlin and Schooler’s (1978) *The Structure of Coping*, referenced in Groer et al. (1992). Pearlin and Schooler (1978) proposed that coping is a behavior that protects people from the psychological harm of problematic social experiences. Individuals cope by eliminating or modifying problem situations, controlling the meaning of the problematic situation, or maintaining the emotional consequences of the problem within manageable bounds (Pearlin & Schooler, 1978). The researchers suggested that their model is best applied to interpersonal, "every day", situations and is not appropriate for crisis situations. Since chemotherapy treatment for cancer is not an every day stress caused by a social experience, the structure of coping model was not chosen for this study.

Roy’s (1984) adaptation model is a nursing framework contending that nurses help individuals to adapt to the manifestations of disease. A major assumption of this theory is that a person’s adaptability is influenced
by the characteristics of the stimulus. It may not be possible to adapt to certain stimuli. No matter how much time a person spends swimming under water, they will not develop gills. Chemotherapy may be a stimulus to which adaptation is not possible. Coons et al. (1987) found that the incidence and severity of chemotherapy related symptoms increased with the number of treatments. The proposed study will test the hypothesis that symptom distress levels will be lower in older children with cancer who receive a virtual reality distraction intervention. A model proposing that distraction will help a person cope with symptoms is more congruent with the proposed hypotheses than a model that suggests distraction will help a person adapt to symptoms.

The combined framework of Lazarus and Folkman's (1984) stress and coping theory and Hinds and Martin's (1988) self-sustaining model provides an explanation for how a coping strategy, such as distraction, can help to mitigate the symptom distress associated with chemotherapy treatment. In this study chemotherapy is viewed as a beneficial treatment which can cause distressful symptoms. Assisting an individual to cope with the time-limited symptom distress can improve daily quality of life and may improve cure rates.
Nonexperimental Approaches

A review of the literature produced a well balanced representation of experimental and nonexperimental approaches to exploring the concept of distraction. Several authors conducted qualitative or descriptive correlational studies. The major finding of these types of studies was that distraction is a coping mechanism utilized by a wide variety of populations.

Distraction as a Coping Mechanism

Several studies demonstrated that a variety of adult populations use distraction as a coping mechanism. Mahon (1991) conducted a qualitative study using a purposive sample of 20 persons with recurrent malignancy. A major emerging theme was that subjects used a limited number of coping strategies, but that distraction was identified as one of the three most common strategies. A participant observation study of 21 residents in a Jewish home for the elderly conducted by Kahn (1990) revealed four story-line themes. One theme was the use of behavioral and cognitive strategies in this population. Distraction was identified as a common coping strategy. Ali and Khalil (1991) identified the self-distraction techniques (keeping busy, doing household work, sewing, or watching television) as one of the top four coping strategies utilized by a sample of 64 female Egyptian mastectomy patients. Barbour et al. (1986) found that 9 out of 58 adult cancer outpatients identified distraction as a
nonanalgesic method of pain control. Chadoff et al., (1964) in a report of parental coping styles based on observations over two years of 46 parents of children with cancer, indicated that distraction and focusing on other responsibilities protected the individual from disruptive levels of anxiety.

**Use of Distraction in Children**

Several studies identified distraction as a common coping mechanism utilized by a variety of school-age and adolescent populations. Ross (1984) provided several case study reports of children ages 6-9 who used a thought-stopping distraction technique to decrease the anxiety. Case reports included a diverse group of children ranging from mentally retarded children visiting the dentist to hospitalized children afraid of venipuncture. Altshuler (1989) conducted a study that correlated the developmental age of children with knowledge of coping strategies. Fifty one elementary school children were divided among three age groups. Behavioral distraction was the most frequently mentioned avoidance strategy by all age groups. These findings were supported by Sorensen (1990), who conducted a study identifying coping responses of 32 healthy 8-11 year olds. Again, behavioral distraction was a routinely used coping mechanism. Carriera et al. (1991) described the sensation of dyspnea in 39 school-age children with asthma and identified distraction as one of the common coping strategies used with this sample.
Groer et al., (1992) conducted a longitudinal panel study of 167 healthy suburban high school students. They found that both girls and boys reported coping with stress mostly through active distraction techniques. Over time, girls’ use of active distraction techniques decreased, while passive distraction increased. Active techniques included walking and exercise. Reading or watching television were classified as passive distraction. A consistent finding of qualitative studies examining coping strategies in children of all ages was that distraction is a frequently used coping mechanism that may be most useful when the child is faced with stressors that are outside of their control (Altshuler, 1989; Sorensen, 1990; Carrieri et al. 1991; Groer, et al. 1992; Sharrer & Ryan-Wenger, 1995).

Several studies have identified distraction as a coping mechanism utilized by children with cancer. Hinds and Martin (1988) used the grounded theory method to study 58 adolescent oncology patients. They identified distraction as one of “four sequential concepts which represent the process adolescents experience to achieve hopefulness” (p.336). Enskar et al., (1997) supported the findings of Hinds and Martin. They identified hope for the future, positive thinking, and keeping busy (a type of distraction) as important components of coping in ten Swedish adolescents with cancer.
Weekes and Kagan (1994) conducted a descriptive longitudinal study which used qualitative methods to explore adolescent coping strategies used during three time periods. Thirteen adolescents were interviewed at three to six months prior to completion of therapy, at the completion of therapy, and six months following the completion of therapy. Prevalent coping patterns while on therapy included positive thinking, not thinking about treatments, business, reinterpretation, and philosophical stance. "Not thinking about treatments", involved focusing on other things and could be classified as a form of distraction. Ninety-two percent of the subjects used this coping mechanism.

Using a descriptive design with a convenience sample of 20 adolescents, Weekes, Kagan, James, & Seboni (1993) compared the phenomenon of hand-holding in two groups (10 with cancer and 10 with renal disease). The intervention of hand-holding, which the authors state served to reduce tension, provide security, and distract the adolescents, was found to be an effective coping strategy in both groups. Despite the limitations from the above studies, which include small sample sizes and studies conducted at a single setting, the findings provide support for the use of a distraction intervention for older children during chemotherapy treatments.

An analysis of coping strategies used for chemotherapy-induced
nausea and emesis in 57 pediatric patients was conducted by Tyc et al. (1995). When experiencing nausea, 85% of patients utilized wishful thinking, emotional regulation and distraction as coping mechanisms. Emesis was managed most by wishful thinking (82%) and emotional regulation (87%). Forty-six percent of children reported that distraction was helpful for controlling nausea and 30% indicated that it was useful for emesis.

Hoffner (1993) conducted a descriptive correlational study which examined how coping patterns in children develop. Using the monitoring/blunting classification proposed by Miller (1987), 60 children aged 6 to 12 were presented with four stories depicting stressful situations that would be difficult to control. After each story, the children were asked what they would do or think about while in the situation. The responses were then categorized using Miller's (1987) framework. Cognitive or behavioral distraction techniques were considered as blunting activities. Results were that girls suggested more coping strategies than boys. Over two thirds of all responses were classified as blunting strategies. There was a significant increase in use of blunting activities with age. No age level differences were found for activities classified as monitoring. This study confirmed the findings of earlier studies that children frequently use distraction as a coping mechanism. It also
supported the notion that coping style develops with age.

Quantifying the Use of Distraction

While the studies reviewed clearly indicate that distraction is a useful coping mechanism in a wide variety of populations, it is important to note that the majority of these studies have been conducted using cancer patients and/or children. A weakness of these studies is that few attempted to quantify either the number of individuals who identified using distraction as a coping technique or perceptions of the effectiveness of distraction. Ali and Khalil (1991) found that 66% of Egyptian mastectomy patients utilized distraction techniques. Groer, et al., (1992) also indicated up to 78% of high school students utilized distraction. Carrieri et al., (1991) state that distraction was identified as a symptom management strategy by 13% of the children with asthma. Tyc, et al., (1995) found that 86% of children receiving chemotherapy used distraction to control nausea. This more recent study was the only one that reported the efficacy of the coping strategy, with 46% of children reporting that distraction was helpful.

Barbour et al., (1986) reported 16% of cancer patients surveyed utilized distraction techniques and 89% of those respondents indicated that distraction helped to manage pain. In a study of 465 randomly selected medical-surgical patients, 239 of whom were in pain, 30%
indicated that distraction methods reduced pain, 60% reported that
distraction methods had no effect on pain, and 6% stated that distraction
methods actually increased pain (Donovan, 1985). Hockenberry &
Bologna-Vaughan (1985) conducted a survey of Pediatric Oncology Group
institutions and found that 20% of institutions used distraction methods
when preparing children for bone marrow aspirations and 30% of
institutions used distraction when preparing children for lumbar punctures.
Identified distraction techniques included music, conversation, and
counting. Wolfe, Blount, Saylor, Dufour, and Finch (1987) conducted a
survey of pediatric oncology nurses at a conference (n = 42). Seventy
percent of the nurses reported knowledge of distraction techniques and
72% reported that they had observed the use of distraction techniques at
least once with a child. Weaknesses of this study included a low response
rate (42%) and no consistent definition of what types of interventions
were classified as distraction.

Experimental Research

Several studies used an experimental approach to manipulate the
independent variable of distraction. The majority of studies explored the
effects of distraction methods on pain. Four of these experiments were
conducted in laboratory settings with student subjects. Maltzman (1988)
studied the reactions of 69 students to slides categorized as pleasant or unpleasant by the researcher. Results indicated that the students found the unpleasant slides significantly more complex and unique than the pleasant slides. The findings suggested that unpleasant slides may be more distracting than pleasant images. The researcher cautioned that the stimulus characteristics of distraction strategies should be controlled for in future studies. Marino, Gwynn, & Spanos (1989) conducted a study in which 80 students participated in three group trials of cold-pressor pain. The effectiveness of imagery or shadowing letters (described as a distraction technique where the individual traces a letter with their finger) as pain relief strategies was directly correlated to the positive or negative expectancy information presented to subjects. Cogan et al., (1987) measured pressure-induced discomfort thresholds 10 minutes following completion of a 20 minute audio tape that was either laughter-inducing, relaxation-inducing, or dull narrative. Subjects who listened to laughter or relaxation tapes had higher discomfort thresholds. The unique finding of this study is that the effects of distraction continue for at least 10 minutes following the activity.

Congruent with the above findings were secondary findings from a study by Stevens and Terner (1993). These researchers conducted a laboratory study of pressure pain tolerance using ninety undergraduate
students who were distributed into three groups. One group was taught and practiced the coping strategy of cognitive distraction. Another group was taught and practiced the coping strategy of sensation monitoring. The third group served as a control. Subjects were asked to rate the effectiveness of the assigned coping strategy. As predicted, distraction and sensation monitoring were more effective than no treatment in modifying pain tolerance and intensity. The distraction strategy was rated significantly more effective than the sensation monitoring strategy (Stevens & Terner, 1993). While subjects viewed distraction to be the more useful than sensation monitoring, perceived effectiveness was not linked to pain tolerance and intensity ratings.

The strength of the laboratory setting studies was that they were well controlled and used large sample sizes. The samples were homogenous, so generalization beyond student populations with experimentally induced pain is not appropriate.

Many clinical studies have explored distraction and pain responses. Levin et al. (1987) compared the effectiveness of rhythmic breathing and Benson's relaxation technique on the postoperative pain of 40 female cholecystectomy patients. The interesting factor in this study was that two control groups were included, one standard control and one group identified as the attention-distraction group which received a tape
recording about the history of the hospital. This study attempted to
differentiate between relaxation and distraction. Differences in analgesic
use between the groups approached significance with the relaxation
groups requiring a lower mean dose for pain relief. A significant difference
in pain ratings was found between the Benson relaxation group and the
distraction control group, but not the standard control group. This
suggested that pain ratings increased in the distraction group. The authors
explained that perhaps the hospital tape was not actually a neutral
distractor. This study supported Maltzman's (1988) research regarding
controlling for the quality of the distraction stimuli.

Flaherty & Fitzpatrick (1978) compared the effect of a jaw-drop
relaxation technique on analgesic use, incisional pain, and respiratory rate
changes. A pretest-post test design using a sample of 40 patients
indicated significant changes in the study group that practiced relaxation.
Broome et al., (1992) conducted a study which explored the effectiveness
of a combined distraction, relaxation, and imagery intervention. This study
was based upon earlier work (Broome et al., 1990) which found that
children who exhibited active coping behaviors during lumbar puncture had
lower pain ratings. Baseline data were obtained on 14 pediatric patients
during the first videotaped lumbar puncture procedure. The children and a
parent were then taught the distraction, imagery, and relaxation exercises.
Additional data were collected during the next two lumbar puncture procedures. Children's medical fears scores and anxiety ratings did not change over time. A limitation of this study is the lack of a control group and the small sample size.

In a similar study, Pederson (1995) compared the effects of imagery, presence, and no intervention on children's pain and anxiety during cardiac catheterization. Eight children were randomly assigned to each of the three conditions. Although no significant differences were found, children in the presence group exhibited the lowest levels of pain, while children in the imagery group exhibited fewer distress behaviors. The author suggests that imagery may not have been a strong enough intervention to produce statistically significant results with the small sample size (Pederson, 1995). A common intervening variable that exists in all the studies using imagery/relaxation techniques is that the researchers did not indicate if, and to what extent, the techniques were practiced.

French, Painter, and Coury (1994) studied the effects of an active distraction intervention in 149 children, 4-7 years old. This experimental research examined the effect of using a blowing technique on pain levels during immunization. Children in the experimental group were taught the technique (similar to blowing bubbles), given time to practice, and then
were coached in the technique during immunization. Significantly fewer pain behaviors were observed in the research group as compared to the control group. There was also a trend toward lower subjective reports of pain by children who used the technique, but no differences were noted in pain ratings completed by the nurse or parent (French et al., 1994). Vessey et al. (1994) used an experimental design to test yet another distraction intervention. In this study a kaleidoscope was used to distract school-age children during venipuncture. Significant differences were found between the control group and the experimental group in levels of perceived pain. Strengths of this study include a large sample size (n = 100) and the use of reliable and valid instruments. Based on reported data an effect size of .7 was calculated for this visual distraction intervention (Vessey et al., 1994).

Redd et. al., 1987 conducted a study to explore the effects of distraction in the control of conditioned nausea. This study used a sample of 15 pediatric patients, with an average age of 12.6, receiving chemotherapy. Video game playing was used as the distraction for two ten minute periods. The researchers utilized a combined ABAB repeated measures ANOVA design in which measures were obtained during a single chemotherapy session. Video game playing resulted in significantly less nausea. Subjects reported reduced anxiety, but changes were not
significant. Pulse rate and blood pressure measures were not affected by the distraction. Changes in nausea did not differ as a function of gender (Redd et. al., 1987). A limitation is that the children were selected from a previously conducted pilot study. The sample included children who expressed a desire to use video games during subsequent treatments. The study was conducted over 10 years ago, when antiemetic therapy was less effective.

Miller, A.C, Hickman, and Lemasters (1992) used an experimental design to determine the effects of a distraction intervention on the dependent variables of burn pain and anxiety. Seventeen subjects were randomly assigned to either a treatment group which viewed video programs of scenic beauty accompanied by music during burn dressing changes or a control group that did not receive the video distraction. The distraction intervention significantly reduced levels of pain and anxiety in the treatment group. A strength of the study was that linear regression was used to statistically control for age, percent partial-thickness of the burn, and type of topical agent used during dressing change. The small sample size was a limitation of this study. An anecdotal note of interest was that several subjects reported being bored after viewing the same video tape several times.

Two empirical studies explored the effect of distraction on the
dependent variable of anxiety. These very similar studies (Gaberson, 1991; Binnings, 1987) tested the effects of auditory distraction on anxiety in ambulatory surgery patients. Binnings (1987) used an experimental pretest-posttest design, where the mean changes in anxiety levels before and one hour post surgery of patients who listened to nature tapes during surgery were compared to anxiety levels in a control group. The experimental group had significantly lower state anxiety scores and required significantly less anesthesia. Gaberson (1991) used an experimental, three-group, posttest design to compare the effects of humorous tape, tranquil music tape, and no intervention on state anxiety prior to surgery. No significant differences were found between groups, but data suggested that humorous distraction appears to be at least as effective as tranquil music. Both these studies had small sample sizes with 5-10 participants in a group. Also, both studies used a visual analog scale to measure state anxiety. The small sample sizes limit the ability to generalize, but these studies were good preliminary work for larger studies on this subject. In a follow-up study in 1995, using the same design, Gaberson used 46 subjects and again found no significant differences among the groups, but both distraction groups had lower levels of anxiety than the control group.

Of particular interest was one study that linked the effectiveness of
a distraction intervention to coping style. Lerman et al. (1990) conducted
a study of 48 adult patients with cancer, which explored the relationship
of coping style to the side effects of chemotherapy and explored whether
coping style moderated the impact of a relaxation intervention on anxiety,
depression, and nausea. Patients in the experimental group were taught a
relaxation technique. All patients completed a measure of coping style
prior to beginning chemotherapy. Correlations indicated that individuals
with a "blunting" or distraction-oriented type coping style reported less
depression, anticipatory anxiety, and nausea than individuals who used a
"monitoring" or information gathering style of coping. Relaxation was
more effective for "blunters". The work of Lerman et al. (1990) was
based on a study by Miller, Brody, and Summerton (1988) which explored
the relationship of coping styles to health-seeking behavior. This study
suggested that "monitors" were more likely to attend to internal bodily
symptoms. The particular strengths of the Lerman et al. (1990) study
were the sample size, the design, and instrumentation. A unique aspect of
this study was that it suggested that individual differences may influence
the effectiveness of a distraction technique.

Gaps in the Literature

Existing studies report that a wide variety of populations use
distraction as a coping strategy for a variety of stressors. Distraction appears to be an effective strategy for coping with pain and anxiety, but how it influences other dependent variables, such as sleep habits, parenting styles, or interpersonal conflict, is unknown. Further exploration is needed to better delineate exactly what are distraction techniques. The literature remains unclear regarding whether imagery is a method of distraction or a separate phenomenon. Most of the empirical studies use very small samples and when significant results are found, the authors neglected to report effect sizes. More studies need to be conducted comparing the effectiveness of different distraction techniques. These studies need to control for the type of distraction stimuli being tested. Data need to be obtained regarding the effectiveness of distraction. Is it useful by itself or only in conjunction with other therapies? Which types of distractions are effective for elderly individuals, young adults, or children? Are there developmental or individual coping style factors that influence the type of distraction that will work with a given population? Only in the last three to five years have studies that specifically identify the concept of distraction appeared in the literature in noticeable quantities. Further research needs to be done if nurses are to be able to use distraction effectively and in appropriate situations.

The qualitative literature has suggested that distraction is a
commonly used coping mechanism in both cancer patients and adolescents. Quantitative data regarding the effectiveness of distraction interventions for specific symptoms are lacking. By measuring symptom distress as a dependent variable, it will be possible to quantify how many patients benefitted from the distraction technique and the type of symptoms the distraction alleviated. Since virtual reality technology blocks the visual sense from surrounding competing environmental stimuli, all individuals may be able to obtain a beneficial response from this distraction technique, regardless of whether they use a monitoring or blunting coping style. Perhaps the immersive quality of virtual reality technology prevents the individual from focusing on alternative stimuli.

Virtual Reality as a Distraction Intervention

Virtual reality technology is a computer simulated technique which allows an individual to hear and feel stimuli that correspond with a visual image. A unique quality of virtual reality as a distraction technique is that it is immersive and interactive (Arthur, 1992). A review of the distraction literature indicates that various distraction techniques such as music, humor, relaxation have been tested, but all of these require that the person consciously and continuously maintain their focus on the distraction strategy. Individuals cannot allow competing stimuli from the environment
to dominate their awareness. The following discussion presents a
definition for virtual reality, discusses why virtual reality is important for
nursing, and presents anecdotal scenarios of how scientists are currently
using virtual reality. The need for virtual reality research will be
documented and results of a few early studies will be presented.

Definition of Virtual Reality

The term virtual reality was first used by Jaron Lanier in 1989. It
was used to refer to a collection of technological equipment capable of
creating a alternative environment (Steuer, 1992). Most of the early
definitions of virtual reality describe electronically simulated environments
which are created using a computer, a type of goggles or headset, and a
way to manipulate the environment with electronic gloves or a joy stick.
A typical equipment driven definition of virtual reality is, "virtual reality is
electronic simulations of environments experienced via head-mounted eye
goggles and wired clothing enabling the end user to interact in realistic

Recently there has been a growing concern that a device driven
definition of virtual reality may be unacceptable (Biocca, 1992: Steuer,
1992). The application of device-driven definitions is limited by the type of
hardware. A variety of manufacturers claim to combine different types of
technologies to create differing virtual reality systems. As a result, it is
not possible to have a consistent definition for the term virtual reality. Steuer (1992) argues that a device-driven definition fails to provide a consistent conceptual framework for communicating with the public, manufacturers, or policy makers.

An alternative to an equipment or technology-driven definition is an experience-driven definition. Biocca (1992) states that one way to define virtual reality is based on the human experience of feeling present in a created environment. Steuer (1992) advocates use of an experience-driven definition based on the concepts of presence, which is viewed as being in an environment, and telepresence which is the "experience of presence in an environment by means of a communication medium" (p. 76). Combining these experience-related concepts, Steuer defines virtual reality as "a real or simulated environment in which a perceiver experiences telepresence" (Steuer, 1992, pp. 76-77). In this situation virtual reality is viewed as a psychological variable that is not limited by specific technological hardware (Biocca, 1992; Laurel, 1995).

Using an experience-driven definition of virtual reality, several antecedents can be identified. The individual must feel present in a created environment. Presence in an environment is experienced by means of a communication medium. Arthur (1992) claims that it is the immersive and interactive qualities generated by computer equipment that makes the
virtual reality experience unique. Pratt et al. (1995) delineate interaction, three dimensional graphics, and immersion as the three necessary elements of virtual reality. Steuer (1992) uses the terms interactivity and vividness to indicate qualities of a communication medium which determine telepresence.

Steuer (1992) concludes that virtual reality is comprised of two interdependent components, human experience, and a technologically mediated environment.

Factors influencing whether a particular mediated situation will induce a sense of telepresence include the following: the combination of sensory stimuli employed by the environment, the ways in which participants are able to interact with the environment, and the characteristics of the individual experiencing the environment. Thus, telepresence is a function of both technology and the perceiver (Steuer, 1992, p.80).

Research Studies using Virtual Reality

Arthur (1992) explains that because virtual reality technology is so new studies on its effects are "mostly small scale and not scientifically rigorous" (p.23). In fact only a few empirical studies could be identified which explored the effects of virtual reality. Mon-Williams, Wann, & Rushton (1993) conducted a study using a sample of 20 young adults to determine the short-term effects on binocular stability. Subjects were examined before and after wearing a head mounted virtual reality display for ten minutes. Some subjects showed signs of induced binocular stress.
The small sample size does not allow for generalization of findings, but clearly more research is needed to determine if visual effects of virtual reality are harmful or any different than those produced by television or video games. In an article by Sieder (1996), the author mentions anecdotally that some virtual reality head sets may cause migraines, vertigo or vomiting. The author warns that the long-term effects of using virtual reality are unknown.

Rothbaum et al. (1995) conducted an experimental study using a virtual reality graded exposure treatment for acrophobia. In this study of twenty college students the experimental group was exposed to several virtual reality scenarios such a foot bridges and outdoor hotel balconies of increasing heights over eight weeks. Significant differences in anxiety, avoidance, attitudes, and distress associated with heights were found between the treatment group and the control group. A limitation of the study is that only seven of ten subjects were able to complete the virtual reality treatment.

Cardio-vascular responses were monitored during a virtual reality simulation of futuristic car races. In this pilot study conducted by Trieber et al. (1995) a virtual reality system was tested with 14 adolescents to determine if a virtual reality stressor could be used for laboratory studies. Subjects exhibited high levels of task involvement and desire to participate.
again in the virtual reality simulation. Results indicated that the virtual reality scenario was more immersive, realistic, and exciting than standard lab stressors such as cold pressor and exercise.

Another experiment compared the value of virtual reality training, real-world training, and no training (Kozak, Hancock, Arthur, & Chrysler, 1993). In this study, 21 subjects performed a pick and place sequence task. There was no significant difference between the group that received no training and the virtual reality training group. The real-world training group performed significantly better than the other two groups. This study challenges the notion that virtual reality task training can be transferred to a real-world situation. The sample size is small and methods of randomization are not delineated.

These experiments question the whether our current expectations for the potentials of virtual reality are valid. Scientists must consider the possible detriments, such as visual changes or altered perceptions, that may occur as a result of the use of virtual reality equipment. It is clear that more research is needed to determine if and how virtual reality can be applied to real world applications.

Need for Virtual Reality Research

While attempts continue to be made to agree on a definition for virtual reality, a consensus exists that more research in the field of virtual
reality needs to be conducted. Phillips (1993) writes that "when virtual reality becomes an actuality in health care, nurse researchers will have to evaluate its usefulness for and application to nursing" (p. 5). A note in The Chronicle of Higher Education (1994) indicated that the Committee on Virtual Reality Research and Development called for increased federal government investment in research to develop better virtual reality software. This committee, which was established by the National Research Council, also indicated that extensive research in the field of virtual reality technology is needed in order to improve health care or education.

Another government group also suggested that virtual reality has the potential to be the nation's most important technology of the decade. The Virtual Reality Task Group, which is part of President Clinton's High Performance Computing, Communications, and Information Technologies Committee, is scheduled to release a report that will also call for government funding of virtual reality research (Patch, 1993). Biocca (1992) calls for research of virtual reality as a communication medium. He advocates that research should explore the relationship between communication design and cognition. The effects of virtual reality on higher order psychological processes should be explored. A review of the literature demonstrates that there is agreement that more research is
needed if scientists are to be able to effectively use this novel tool which is called virtual reality.

Examples of Virtual Reality Applications

While most people will first experience virtual reality as a form of entertainment, advocates of virtual reality envision this new technology with applications for education, health care, business, and the military (LeFevre, 1994). Scientists are beginning to comprehend the wide array of possibilities for virtual reality applications. The field of virtual reality research is still in its infancy and developmental stages. Scientists are building prototype models for various uses. Research to date is in the descriptive or case example phase. As of yet, very little empirical research exists which studies the effects of virtual reality on large samples. The following section provides a sense of the various virtual reality applications currently being explored by scientists.

A variety of medical applications for virtual reality are currently being tested. One of the most common applications is to use virtual reality to enhance surgical techniques. Virtual reality simulation of surgical procedures has been developed as a teaching tool to perfect surgical skills (Grimes, 1991; Stix, 1992; Taubes, 1994). Virtual reality surgical simulators can help surgeons learn to control hand tremors or obtain more practice on rarely performed techniques (McGovern & Tehrani, 1997).
Another of the many hypothesized applications is remote surgery. A surgeon could be able to operate in a virtual reality work station and the movements could be transmitted to the actual surgical site, thus allowing a physician to perform surgery without being physically present in the operating room (Dutton, 1992; Taubes, 1994). Digitally stored simulations of surgical scenarios could enhance resource utilization by providing educational opportunities for new surgeons or by providing a "practice opportunity" prior to infrequently performed procedures (Gupta, Klein, & Mehl, 1996).

A military application for remote surgery currently being explored, is equipping soldiers with remote sensors which could transmit information about a soldier's battle wounds to a military physician who could make proper triage decisions. One possibility would be to send a remote telepresence surgery vehicle to the soldier. Remote surgery could then be preformed immediately by a surgeon back in the MASH hospital (Satava, 1995). The military is also developing a virtual reality system to model wound healing. A scanner is used to capture a three dimensional model of the wound including color changes and wound borders. The computer visualization would then be used as a non-invasive way to evaluate treatments (Mahoney, 1996).

Virtual reality systems are also being used for motion analysis and
physical therapy applications. Baseball players are using a data glove to analyze pitching movements in order to improve athletic skills (Dutton, 1992). In Palo Alto, physical therapists are using a virtual reality body suit to understand body movements. The suit could be programmed to slow movements in order to help reteach individuals how to walk or eat. As individuals with brain injury or stroke relearn various motions involved in tasks of daily living, the virtual reality suit is programmed to gradually help increase speed and dexterity (Grimes, 1991; Dutton, 1992).

Suzanne Weghorst at the University of Washington in Seattle, is using virtual reality glasses to help enhance gait control in individuals with Parkinson's disease (LeFevre, 1994). Virtual reality systems can also help with rehabilitation and to improve the quality of life for quadriplegic persons. Using only their eyes, quadriplegics have been able to use virtual instruments to move objects and to communicate (Dutton, 1992; Kahlen & Dohle, 1995). Kahlen and Dohle (1995), also describe possible virtual reality applications for assisting with disabilities. Virtual reality systems have been used to translate sign language into written text. Building plans can be tested for wheel chair accessibility using simulated rooms.

Sieder (1996) reports that experiments are currently being conducted which treat anxiety disorders. Virtual reality is being tested as a treatment for acrophobia, fear-of-flying, fear-of-spiders, anxiety about
diving, and post-traumatic stress in war veterans (Rothbaum et al., 1995; Salyer, 1997). Pugnetti et al. (1995) describe the potential use of virtual reality for enhancing the evaluation and management of cognitive impairments in adults. A virtual reality headset could be worn while the patient is instructed to find his way out of a simulated building. The headset would monitor behavioral data as well as to help provide cues to enhance problem solving skills.

Virtual reality has educational applications as well. Students could learn about physics in a more experiential manner. Virtual reality can be used to help students understand concepts such as friction or what happens when a ball is bounced on Jupiter (Stix, 1993). University of North Carolina researchers are using virtual reality systems to better understand the actions of how a drug binds with an enzyme (Stix, 1991). At the University of Washington a simulation of an emergency room is being developed to help medical students get "hands on" experience with X-rays, EEG readings and CAT scans. The system is expensive and problems exist integrating the technology (Brown, 1996).

Research needs to conducted regarding how virtual reality systems can help to improve classroom learning. Knox, Schacht, and Turner (1993) advocate the use of virtual reality to decrease test anxiety. They theorize that the desensitization process currently used to treat test
anxiety could be successfully performed using a virtual reality environment which would simulate the sights, sounds, and sensations present in a testing room. The student could use virtual reality to practice entering the test room, taking a seat and receiving a test.

Simulated situations can be created using virtual reality to help improve productivity. NASA scientists are using virtual reality to simulate wind tunnel conditions and to run space shuttle experiments. Initial testing with virtual reality is safer and less expensive than using the wind tunnel (Morgan, 1994). The Army Research Laboratory in Maryland uses virtual reality to familiarize soldiers with dangerous terrain at potential combat sites (Morgan, 1994). Fire Fighters are conducting research with virtual reality to better understand how people react in alarm situations (Geake, 1992). The possibilities for virtual reality applications seem limitless. In the next decade virtual reality will influence the way individuals learn, work and receive health care.

Virtual Reality as a Tool for Nurses

One can hypothesize many ways in which nurses will be able to use virtual reality. Professional and patient teaching could be improved by using virtual reality models to practice changing dressings, providing hygiene care, or administering medication (McConnell, 1996). Virtual reality environments could be created which would allow nurses to practice
decision making. For example, a nurse could practice how to set priorities when caring for seven patients, all of whom require differing levels of nursing intervention. Nurses could use virtual reality as a distraction intervention during painful procedures or to prevent boredom during long periods of hospitalization. Dentists are experimenting with using virtual reality to distract patients during dental procedures. For those patients who would benefit from confronting reality rather than escaping it, virtual reality also could be therapeutic. Individuals could use virtual reality to learn how to replace disruptive thoughts or to practice effective problem solving (Shapiro & McDonald, 1992).

Barrett (1993) explains how virtual reality is congruent with Roger's science of unitary human beings. Roger's theory states that "nurses pattern the environment to promote comfort, well-being, health, and healing" (Barrett, 1993, p.14). Virtual reality can be used to pattern the environment for health. The Rogerian view is that the person as an energy field is infinite and is not bound by the physical body. Virtual reality "allows a person to experience their energy field in a place where the physical body is not present" (Barrett, 1993, p.15). Barrett (1993) advocates using virtual reality to test the Rogerian postulate that seeing and hearing are more than sight and sound. This author believes that virtual reality experiences may increase nursing's understanding of human
perceptions, transcendence, and the human-environmental mutual process.

**Obstacles to Virtual Reality**

While the possible applications for virtual reality technology seem endless, many obstacles remain before a reasonable body of knowledge will be available in this new field. Computer technology is not yet refined enough to cost effectively perform many of the conceived applications. Often graphic images are not realistic enough and the time needed to transmit electronic messages is delayed, making applications like remote surgery difficult. Equipment is often cumbersome, lacks portability, and requires extensive training in order to operate (Burt, 1995; McGovern & Tehrani, 1997; Salyer, 1997).

"Cybersickness," or possible side effects from virtual reality simulations may be yet another obstacle. The phenomenon was first observed following the use of simulators for military applications, such as flight training. Side effects reported included cold sweats, motion sickness, headaches, fatigue, nausea, and vomiting (Strauss, 1995). It is uncertain how long these side effects last. Whalley (1995) warns that virtual reality treatments may exacerbate the mental conditions that they are being used to treat. Strauss (1995) states that articles about virtual reality emphasize the technology and often neglect to mention any possible hazards. In the articles reviewed, there was no mention of motion
sickness or other symptoms that would exclude subjects from participating in virtual reality studies.

Gaps in the Virtual Reality Literature

Almost all of the virtual reality literature consists of theoretical applications or reports of uses with limited subjects under very controlled conditions. No large scale studies which empirically tested these new applications could be found. Innovative technology does not always guarantee improved outcomes. No studies could be found which compare traditional interventions such as conventional physical therapy to gait training using virtual reality. There also is a lack of information regarding potential hazards or ethical concerns regarding the use of virtual reality technology (Whalley, 1995). No studies could be found which explored the recreational or distraction qualities of virtual reality as a possible therapeutic intervention.

Conclusion

This chapter reviewed the literature regarding chemotherapy related symptom distress and the use of distraction as a nursing intervention. Gaps in the distraction research were identified and some suggestions for attempting to resolve these issues with a virtual reality distraction intervention were presented. Literature from the emerging field of virtual
reality research was also presented. It is clear that there is a paucity of empirical research which demonstrates the usefulness of virtual reality in patient care. Conducting a study using virtual reality as a distraction intervention and symptom distress as the dependent variable will contribute to the body of nursing knowledge regarding the application of distraction and virtual reality.
Chapter III

METHOD

This study utilized an interrupted time series design with removed treatment to determine the effects of a virtual reality treatment on chemotherapy related symptoms in children with cancer. This chapter presents the hypotheses, study design, sampling methods, setting, research variables, and data collection procedures. Methods for protecting human subjects and data analysis are discussed.

Research Questions & Hypothesis

Q(1) Will general symptom distress levels be lower in children with cancer who receive a virtual reality distraction intervention during a chemotherapy treatment as compared with symptom distress levels in the same children during the chemotherapy treatment prior to, and following the use of the virtual reality distraction intervention?

H (1) There will be differences in measures of symptom distress immediately following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

Q(2) Does the virtual reality intervention have a lasting effect on children
that is capable of mitigating chemotherapy related symptoms over time? H (2) There will be differences in measures of symptom distress two days following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

Design

An interrupted time series design with removed treatment was used to answer the research questions. For each of three chemotherapy treatments, one pre-test and two post-test measures were employed. During each of the three chemotherapy treatments, subjects received the usual and customary care including regularly prescribed pharmacotherapy. Subjects received the virtual reality distraction intervention while receiving the second chemotherapy treatment. Figure 3 diagrams the study design.
Figure 3

Study Design and Data Collection Schedule (n = 12)

<table>
<thead>
<tr>
<th>aC1</th>
<th>pC1</th>
<th>p48C1</th>
<th>aC2</th>
<th>C2</th>
<th>pC2</th>
<th>p48C2</th>
<th>aC3</th>
<th>pC3</th>
<th>p48C3</th>
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</thead>
<tbody>
<tr>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>X</td>
<td>O₅</td>
<td>O₆</td>
<td>O₇</td>
<td>O₈</td>
<td>O₉</td>
</tr>
</tbody>
</table>

O₁ = Demographic Data, Symptom Distress Scale, & STAIC C-1, single item indicators for nausea and vomiting
O₂ - O₉ = Symptom Distress Scale, STAIC C-1, single item indicators for nausea and vomiting
X = Virtual Reality Distraction Intervention
O₅ = Qualitative Evaluation of Intervention

The pre-test measure of symptom distress was conducted immediately prior to chemotherapy. The major purpose of this measure was to establish baseline symptom distress levels that may be attributed to the participant's cancer. The post-test measures were designed to capture symptom distress levels when there was likely to be an effect from the intervention. The post-test measures attempted to capture; 1) any immediate effects of virtual reality, 2) lasting effects that could mitigate symptoms for the critical 48 hour period post chemotherapy, when the participant was most likely to experience symptoms, and 3)
long term effects that could decrease anticipatory nausea or anxiety prior to the third chemotherapy treatment.

Cook and Campbell (1979) state that time series designs are appropriate when there are multiple observations over time. The researcher must know at which specific point in the series of observations that the treatment occurred (Cook & Campbell, 1979). The purpose of a time series design is to infer whether the treatment had an impact. When a limited number of subjects are available, a repeated measures design is advantageous because each individual is measured on several occasions corresponding to each treatment level. Thus each person serves as their own control, eliminating the need for randomization to produce group equivalency (Girden, 1992).

An advantage of the time series design is that posttreatment differences "cannot be attributed to individual characteristics" (Girden, 1992). Major disadvantages of this design include threats due to attrition and resentful demoralization (Cook & Campbell, 1979; Girden, 1992). The effects of practice and fatigue must be considered when using this design. Improvements could either be attributed to the treatment or the effects of practice. Similarly a decline could be attributed to the treatment or fatigue. There also may be a latency effect, where the effect of the first treatment is not seen until after the second treatment
has been introduced (Girden, 1992).

Sample

The population for this study was children who were scheduled to receive chemotherapy as part of their treatment plan for malignant disease. A convenience sample of 12 children was selected. Inclusion criteria for study participants were: 1) age 10-17, 2) first diagnosis of cancer, 3) within the first 4 months of their initial chemotherapy regime, 5) require at least three additional cycles of intravenous chemotherapy to complete their treatment, 6) able to read and write English, 7) without clinical evidence of primary or metastatic disease to the brain or history of seizures (Picket, 1991) and 8) without a history of motion sickness.

Rationale for Sample Size

Sample size predictions employed the use of power analysis. The following parameters were used; probability of a type one error of 0.10, a power of .80, and an effect size of .50. Using the power chart for a single-sample repeated measures design, a sample size of 8 was calculated (Vonosh & Schork, 1986). Use of this sample size allowed for detection of differences due to the proposed virtual reality intervention.

In manuscripts that provided enough data to calculate effect size,
the values ranged from .7 (Flaherty & Fitzpatrick, 1978; Vessey et al., 1994) to .95 (Gaberson, 1991). Lipsey (1990) categorizes these measures of effect size as being in the large range. A more conservative effect size of .50 was used because this particular distraction intervention had not been tested previously.

An alpha of .10 was selected based on an analysis of the risks and benefits of type I versus type II error (Lipsey, 1990). Relaxing the criteria for significance to a .10 level indicates that the risk of falsely rejecting the null hypothesis, when the intervention was in fact not effective, was judged a lesser risk in this study than falsely accepting the null, discrediting an effective treatment. Cohen (1988) recommends a desirable minimum statistical power of .80. The table by Vonesh & Schork (1986) required an additional calculation. The detectable difference (1.25) was obtained by dividing the effect size (.50) by the variability among subjects at the first measurement (.39).

Twelve individuals were recruited. This over sampling was done to compensate for possible attrition or incomplete data. It was expected that attrition rates would be minimal (less than 10%) because of the short time lapse between pre and post measures of the symptom distress scale (48 hours). In fact, all recruited subjects completed the nine time measures in the study. This was similar to the experience of other
researchers. Rhodes et al. (1984) conducted a 5 month longitudinal study using an adapted symptom distress scale to determine patterns of nausea and vomiting. Thirty two of 42 subjects completed the study. The Symptom Distress Scale was well received with children and adolescents and proven easy to complete (J.E. Haase, personal communication, 1994; Hinds et al., 1992). Neither researcher had problems with missing data. For this study there was no missing data. Questionnaires were completed by the subjects and then checked by the investigator to help assure that the forms were filled out completely.

Setting

A large midwestern teaching hospital was used as the setting. The facility is recognized as a Clinical Cancer Center by the National Cancer Institute and receives regional referrals for treatment of children with cancer. The institution offers both inpatient and outpatient facilities for the treatment of cancer. This study was conducted in the outpatient setting. It took approximately 16 months to recruit the twelve children with cancer who met the inclusion criteria in this setting.
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Time Line

The subject recruitment, data collection, data entry, and data analysis took 18 months. A time line is presented below.

<table>
<thead>
<tr>
<th>Time</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 1996</td>
<td>Institutional Review Board Approval</td>
</tr>
<tr>
<td>Spring 1996 - Oct. 1997</td>
<td>Subject Accrual, Collect Data, Data Entry &amp; Clean Data</td>
</tr>
</tbody>
</table>

Definitions of Major Study Variables

Theoretical Definitions

Virtual reality - Virtual reality is defined as a distraction technique. Virtual reality meets the criteria for a distraction intervention because it diverts the focus of attention away from the stressful stimuli (Hockenberry & Bologna-Vaughan, 1985; Gaberson, 1991). Physically described, it is a computer simulated technique that allows an individual to hear and feel stimuli that correspond with a visual image. The individual wears a head set which projects an image with the corresponding sounds. The sense of touch is involved through use of a computer mouse that allows manipulation of the image or transfer of touch sensation. Subjects used the virtual reality headset during their intravenous chemotherapy treatment. Distraction occurs because the person feels present in the
simulated environment (Steuer, 1992).

**Symptom distress** - Symptom distress is defined as the symptoms experienced by the cancer patient. Symptom distress was measured at nine time points using the Symptom Distress Scale (McCorkle, & Young, 1978) as a general indicator. Specific indicators of symptom distress used included the State-Trait Anxiety Inventory for Children (Speilberger, 1970), and single item indicators for nausea and vomiting.

Using a broad outcome indicator such as general symptom distress was beneficial because virtual reality had not yet been tested as a distraction intervention. By measuring general symptom distress it was possible to look for overall effects as well as effects associated with each specific subscale. The STAIC C-1 and single item indicators tested outcomes for specific symptoms such as nausea, vomiting, or anxiety.

**Operational Definitions**

**Virtual reality** - The use of a Virtual i-O brand headset worn by children during an intravenous chemotherapy treatment for cancer.

**Symptom distress** - A general indicator of symptoms experienced by the cancer patient. The Symptom Distress Scale (SDS) (McCorkle, & Young, 1978) was used to measure the global concept of symptom distress.

Other specific measures of symptom distress included single item
indicators for nausea and vomiting, and the State-Trait Anxiety Inventory for Children (STAIC C-1) (Spielberger, 1970) to measure state anxiety.

Instruments

Symptom distress

Symptom distress was measured by the Symptom Distress Scale (SDS), originally developed by McCorkle, & Young, (1978). The SDS is a general indicator of symptoms experienced by the cancer patients. The instrument is a 13 item scale measuring a variety of physical and psychological symptoms. The severity of each symptom is rated on a five point Likert-type scale with a rating of one indicating absence of distress and a rating of five indicating extreme distress. Total scores range from 13-65 and are obtained by adding the scores obtained for each of the scale items. The scale takes 5-10 minutes to administer.

The instrument was developed to identify concerns of patients receiving chemotherapy treatments. The reliability and validity of this instrument are well established (McCorkle, 1987). The tool has demonstrated construct and content validity for specific symptoms. A correlation of .90 between SDS score and scores on the Ware’s health perception questionnaire demonstrates convergent validity (McCorkle, 1987). The reliability coefficient alpha has been reported at values
between 0.79 and 0.89 in numerous samples of adult cancer patients (McCorkle, 1987). The scale discriminates between heart patient survivors and cancer patients (McCorkle, & Quint-Benoliel, 1983) as well as between home care patients and controls (McCorkle, 1987).

The instrument was chosen because it can measure changes in symptoms distress within a single individual over time (Hinds et al., 1992; McCorkle, 1987). The scale has been used without modifications in studies of children with cancer by Haase (personal communication, 1994), and in adolescents with cancer (Hinds et al., 1992). Hinds et al. (1992) reported internal consistency levels of .82 and .85 in two samples of adolescents with cancer. Reliability testing for Haase’s population of adolescents resulted in a coefficient alpha of .91 (personal communication, J. Haase, 1994).

Since virtual reality as a distraction intervention had not been clinically tested, it was difficult to predict exactly which symptoms this intervention would alleviate. The SDS is an instrument measuring the occurrence of specific symptoms and provides an overall score of symptom distress and is ideal for determining the effectiveness of this intervention. A review of the literature suggested that anxiety, nausea, and vomiting may be the symptoms most prevalent in the study population (Coons et al., 1987). Measures for these specific symptoms
were included.

**State Anxiety**

The STAIC was developed based on the same conception of anxiety that guided the development of the State-Trait Anxiety Inventory for Adults (Speilberger, 1966). The STAIC C-1 was developed to measure transitory anxiety states in children which includes anxiety induced by stressful procedures. The instrument was developed for children nine to twelve years, but may be used in older children (Speilberger, 1970). It is a twenty item, Likert-type questionnaire which requires 8-12 minutes to complete. Scoring weights range from 1-3 for each item with half of the items being reverse scored. A total score ranging from 20-60 is obtained by adding the weighted score for each item.

Alpha reliability for the STAIC C-1 ranged from .82 to .87 for a sample of fourth, fifth, and sixth graders. Evidence of construct validity is provided by comparing baseline scores on the STAIC C-1 in a sample of 900 fourth, fifth, and sixth graders with scores obtained when the children were asked to report how they would feel before a final examination. Mean scores were higher for the TEST condition (males, 41.76; females, 43.79) as compared to the NORM condition (males,
31.10; females, 31.03) (Speilberger, 1970).

**Single Item Indicators: Nausea and Vomiting**

Single item indicator measures were obtained for the specific symptoms of nausea and vomiting. Wewers and Lowe (1990) report that visual analog scales provide a convenient and easy way for nurses to measure subjective phenomena which are dynamic in nature. Examples of such phenomena include; functional ability, pain, quality of life, nausea, and vomiting (Wewers & Lowe, 1990). Youngblut and Casper (1993) advocate the use of single item indicators as valid measures of global concepts that are sensitive to individual differences. Single item indicators are acceptable second measures of a concept. Validity estimates can be obtained correlating responses with the corresponding items on the SDS (Youngblut & Casper, 1993). Participants were asked to provide a global rating of each symptom using a visual analog scale with numerical anchors ranging from 1- 5. Reliability and validity indicators of single-item measures are consistent regardless of response format (Youngblut & Casper, 1993).

An open ended questionnaire was used to provide a subjective evaluation of the intervention in order to determine how well the intervention was received and to improve administration of the
intervention in future studies.

Reliability of Instruments

For the current study, Cronbach's alpha coefficient was calculated as a measure of internal consistency. An alpha coefficient was determined for the first administrations of the Symptom Distress Scale and the State Anxiety Inventory for Children. A reliability coefficient of .80 or greater was considered acceptable.

The alpha coefficient for the Symptom Distress Scale was .85. This value was consistent with the high levels of internal consistency found by Hinds et al. (1992). They reported internal consistency levels of .82 and .85 in two samples of adolescents with cancer. The alpha coefficient for the State Anxiety Inventory for Children was .86. Spielberger (1970) reports alpha reliability for healthy children ages 10 to 13 ranged from .82 to .87. The obtained alpha coefficients for this sample were similar to those of previous researchers and supported the reliability of the instruments in this sample.
Data Collection

Procedure

The weekly pediatric oncology interdisciplinary meeting was attended each Monday morning by the investigator. At this meeting all pediatric oncology patients who are receiving treatment were discussed. Potential study participants, who met the inclusion criteria were identified. Prior to the next scheduled chemotherapy treatment, the investigator contacted the parents and potential participants via telephone. The purpose of the telephone call was to briefly explain the study and inform them that they would be asked to participate in the study when they come to the clinic for their chemotherapy appointment.

Upon arrival at the clinic, potential participants and their parents were escorted to a private room. The investigator explained the study, answered questions, and obtained consent. Written informed consent was obtained from a parent or guardian. Written assent was also obtained from the subject prior to study participation. To assure that subjects were informed regarding what was involved in participating in the study, they were asked to describe in their own words the purpose of the study and what was expected of them as participants. Subjects were also told that they would be free to withdraw from the study at any time and that withdrawal would not affect their care in any way.
After consent was obtained, demographic data including information regarding previous use of distraction interventions was collected. It took approximately 20 minutes to administer the demographic form, SDS, STAIC C-1, and single item indicators for nausea and vomiting. To reduce the threat of resentful demoralization, subjects were told that data would be collected during three chemotherapy treatments, but that due to equipment availability, they would only use the virtual reality during one of the treatments. In actuality, all subjects used the virtual reality during their second treatment.

Following completion of the questionnaires, subjects then received their first chemotherapy treatment. Normal and customary procedures such as pretreatment teaching, accessing indwelling venous catheters, administering chemotherapy, providing home going instructions, and administering antiemetic medications was done by the outpatient clinic registered nurse. Immediately following the administration of intravenous chemotherapy, the individual was asked to complete the SDS, STAIC C-1, and single item indicators for nausea and vomiting for a second time.

Arrangements were made by the investigator to contact the subject 2 days following the completion of the first chemotherapy treatment to complete a third SDS, STAIC C-1, and single item indicators for nausea
and vomiting. These measures were completed via telephone with the investigator. Participants were provided paper copies of the instruments to complete 48 hours following the completion of chemotherapy. The investigator called the participant at a prearranged time (48-52 hours following the completion of chemotherapy) to record the participant's answers to instruments.

The above procedures were followed for the next two chemotherapy treatments except that during the second treatment, the participants received the virtual reality distraction intervention. For this treatment, the investigator showed the child the virtual reality equipment and provided a brief standard explanation of how to use it. The participants were able to choose from one of three possible virtual reality scenarios. The commercially available scenarios were available on CD ROM and were; Magic Carpet®, Sherlock Holmes Mystery®, and Seventh Guest® (a haunted mansion). The subjects used the virtual reality for five minutes to get accustomed to the equipment and then the intravenous chemotherapy was administered by a clinic nurse. The individuals continued using the virtual reality equipment throughout the administration of chemotherapy. Again, all normal and customary nursing procedures were followed by the clinic nurse. Following the administration of intravenous chemotherapy, the virtual reality equipment
was removed and a subjective evaluation of the intervention was completed in addition to the standard measures.

All data collection was completed by the principal investigator. Standard instructions for completion of questionnaires was provided in writing at the top of each instrument. Instructions were read to each subject. Data collection was completed in eighteen months.

Human Subjects

Prior to initiation of the project, the study was approved by the Human Subjects Review Boards of Frances Payne Bolton School of Nursing, Case Western Reserve University, Rainbow Babies & Children's Hospital, and University Hospitals of Cleveland. Written informed consent was obtained from a parent or guardian. Written assent was also obtained from the subject prior to study participation. Confidentiality and the right to withdraw at any time was guaranteed. Twelve eligible subjects were identified and asked to participate in the study. All twelve subjects agreed to participate and completed the study.

No potential hazards to subjects, investigator or hospital personnel were anticipated. There were no risks from any of the data collection procedures although at times subjects could find them inconvenient or time-consuming. Every effort was be made to prevent this
inconvenience. Often data were collected while subjects were waiting to see the physician or while waiting for chemotherapy to be prepared. Subjects spent approximately 10-20 minutes during their clinic visits answering questionnaires.

There were no specifically documented risks associated with use of the virtual reality equipment, but subjects could have possibly experienced motion sickness or fatigue while using the headset which could worsen chemotherapy related nausea. Subjects were informed that they could discontinue use of the virtual reality headset at anytime, by simply taking off the head set. If a patient experienced nausea, they would have been treated with their regularly prescribed antiemetics. A potential benefit of this study was that use of virtual reality may have been enjoyable and may have made the chemotherapy treatment more tolerable.

Subjects were assured that their participation was voluntary and refusal to participate would not affect any other care or treatment they received. Subjects were informed that they could withdraw from the study at any time with no effect upon the care they received. There were no departures from usual treatment for patients, except that participants were asked to use the virtual reality equipment during their second chemotherapy treatment and to complete the study.
questionnaires. There were no costs to subjects for participation in the study. Subjects were not be paid for their participation.

Confidentiality was assured in the following manner. All responses remained anonymous and results were reported in aggregate form. Data collection forms were identified by sequential subject research numbers. No names appeared on the data collection forms. An index of subjects' names, medical records numbers, and research identification numbers was kept in locked project files during the data collection phase. Data were kept on disks and papers stored in the investigator's research office. Only personnel directly related to the project had access to the data. All data sets and diskettes will be stored by the investigator for a period of seven years.

Data Analysis

Following collection, the data was entered into a SPSS data file for analysis. The data was coded and transformed according to guidelines for the STAIC C-1 (Spelberger, 1970). Frequencies were calculated for each variable to determine the distributions, variances, and to identify outliers. Values greater than 2 standard deviations or less than -2 standard deviations were considered outliers. All questionnaires were complete and there were no missing data. Individual subject profile analysis graphs
were used to evaluate patterns of symptom distress over the nine time measures. The following procedures were used to test the two research hypotheses.

**Testing the Hypotheses**

H (1) There will be differences in measures of symptom distress immediately following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

H (2) There will be differences in measures of symptom distress two days following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

To test these hypotheses repeated measures ANOVA was used. This technique is used when observations are taken on subjects over time (Sidani & Lynn, 1993). Repeated measures ANOVA were done on all measures of symptom distress. These measures include, the SDS, the
STAIC C-1, and the single item indicators for nausea and vomiting.

The assumptions of univariate repeated measures ANOVA are: 1. For all subjects, the spacing of measures must be the same. 2. There should be an equal number of observations for each subject. 3. All the observations within each factor level must be independent. 4. Multivariate normality and 5. Variance-covariance assumptions. (Shott, 1990; Sidani & Lynn, 1993). Shott (1990) states that random sampling is not crucial for a one-factor repeated measures ANOVA testing. The study design meets the criteria for assumptions one through three. Prior to data analysis, the investigator verified multivariate normality by examining histograms of each factor level for all measures of symptom distress. For each repeated measures ANOVA test, Mauchly’s test was calculated. If the p-value of Mauchly’s test was greater than or equal to the alpha (.10), it was assumed that the variance-covariance assumptions were reasonable for the data (Shott, 1990). The null hypothesis will be rejected at the p < .10 level.

**Qualitative Evaluation of the Virtual Reality Intervention**

Descriptive statistics were used to evaluate responses to the subjective evaluation of the virtual reality intervention. This was done in order to determine how well the intervention was received and to improve
administration of the intervention in future studies.

Summary

This chapter presented a feasible plan to examine the effects of a virtual reality distraction intervention on the chemotherapy-related symptoms in a population of pediatric oncology patients. The rationale for design, methods, and data collection procedures were presented. Methods for data analysis were discussed.
CHAPTER IV

RESULTS

The purpose of this study was to test the premise that virtual reality as a distraction intervention decreased the symptom distress associated with chemotherapy treatments in children aged 10-17. In this chapter, a description of the sample, evaluation of statistical assumptions, and results of statistical analyses of the research questions will be presented. All statistical calculations were conducted using SPSS for Windows version 6.0 software. The research questions and hypotheses were:

Q(1) Will general symptom distress levels be lower in children with cancer who receive a virtual reality distraction intervention during a chemotherapy treatment as compared with symptom distress levels in the same children during the chemotherapy treatment prior to, and following the use of the virtual reality distraction intervention?

H (1) There will be differences in measures of symptom distress immediately following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

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Q(2) Does the virtual reality intervention have a lasting effect on children that is capable of mitigating chemotherapy related symptoms over time?

H (2) There will be differences in measures of symptom distress two days following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

Description of the Sample

Recruitment of the 12 subjects for this study took approximately 16 months and data collection lasted 18 months. Subjects were recruited from May, 1996 through September, 1997 with the last point of data collection occurring in October of 1997. Subject accrual was evenly distributed across the length of the study with a new subject being recruited approximately every six weeks. The shortest time between subject accrual was 2 weeks and the longest period was 10 weeks.

Twelve eligible subjects were identified at the weekly interdisciplinary meeting. All twelve subjects agreed to participate and completed the nine time measures in the study. Recruited subjects ranged in age from 10 to 17 years with a mean age of 14.0 (SD = 2.34). Seven males (58%) and five
females (42%) participated in the study. The diagnoses of the subjects were acute lymphocytic leukemia (ALL): 8 (66.7%) and hodgkins lymphoma (HL): 4 (33.3%). Subjects represented three different ethnic groups: Caucasian 8 (67%), African American 3 (25%), and Arab-American 1 (8%). Only two of the twelve subjects (17%) had any prior experience with virtual reality.

One subject was eliminated as an outlier. The criteria for elimination are discussed later in this chapter. Final data analysis was based on a sample of 11 with the following characteristics. Age ranged from 10 to 17 years (m = 14.0, SD =2.45). Data from six males (55%) and five females (45%) were used. Seven subjects had a diagnosis of leukemia (64%) and four subjects had a diagnosis of hodgkins lymphoma (36%). Ethnic identification was: Caucasian 8 (73%), African American 2 (18%), and Arab-American 1(9%). Table 1 summarizes the demographic characteristics of the sample.
### Table 1

**Demographics of Sample**

<table>
<thead>
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<th>Variable</th>
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<th>Analyzed (n=11)</th>
</tr>
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<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10-17 m=14 SD=2.34</td>
<td>10-17 m=14 SD=2.45</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
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<tr>
<td>Male</td>
<td>7 (58%)</td>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
<td>5 (42%)</td>
<td>Female</td>
</tr>
<tr>
<td><strong>Diagnosis</strong></td>
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<td></td>
</tr>
<tr>
<td>Leukemia</td>
<td>8 (66.7%)</td>
<td>Leukemia</td>
</tr>
<tr>
<td>Hodgkins</td>
<td>4 (33.3%)</td>
<td>Hodgkins</td>
</tr>
<tr>
<td><strong>Ethnic Identification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>8 (67%)</td>
<td>Caucasian</td>
</tr>
<tr>
<td>African Amer.</td>
<td>3 (25%)</td>
<td>African Amer.</td>
</tr>
<tr>
<td>Arab Amer.</td>
<td>1 (8%)</td>
<td>Arab Amer.</td>
</tr>
</tbody>
</table>

As the inclusion criterion stated, all of the subjects were enrolled within their first four months of starting chemotherapy treatments. The subjects diagnosed with acute lymphocytic leukemia received their initial chemotherapy treatment while hospitalized, when they were first diagnosed. The leukemia subjects were enrolled in the study for their first outpatient chemotherapy treatment, which was actually their second protocol treatment. The protocols for leukemia required weekly chemotherapy treatments, depending on complete blood count and differential parameters. Most patients received weekly treatments as scheduled, although several patients had delays up to 2 months because of low blood counts. The
intravenous chemotherapeutic agents the leukemia patients received while enrolled in this study were either daunomycin with vincristine or cytosine arabinoside.

The Hodgkin's lymphoma patients received all of their chemotherapy treatments in the outpatient center. All of these subjects were enrolled in the study prior to their first chemotherapy treatment. Hodgkin's lymphoma patients were treated with alternating chemotherapy regimens every two weeks. The first treatment the subjects would receive cyclophosphamide and vincristine, and the next treatment they would receive doxorubicin and bleomycin. In order to control for the emetogenic qualities of the chemotherapeutic agents, data were collected during matched chemotherapy treatments. The time interval between each of the three chemotherapy treatments used for data collection in this study was four weeks.

Missing Data and Outliers

All twelve subjects completed the nine time measures. There were no missing data. To check for outliers individual profile graphs of the measures of symptom distress were produced for each subject. One subject's graph was distinctly different from the others. This subject demonstrated higher symptom distress levels throughout the entire second
chemotherapy treatment. Scores on the Symptom Distress Scale for this subject were 30 for the prechemotherapy measure and 23 for the immediately post chemotherapy measure. Both of these values were two standard deviations above the sample mean.

A data collection notebook had been maintained by the investigator. The notations indicated that the subject had experienced mental status changes approximately 30 minutes following the chemotherapy treatment and had to be hospitalized for evaluation. Hospital records indicated that the mental status changes were attributed to chemotherapy toxicity. The chemotherapy drug this subject received, cytosine arabinoside, has a ten percent incidence of neurotoxicity (Wilkes, Ingerson, & Burke, 1997). Investigator notes indicated that the subject was somnolent and had difficulty completing the written portion of subjective evaluation of virtual reality intervention. Data from this subject were excluded in the final analysis.

Measures of Symptom Distress: Descriptive Data

The following section provides an overview of each of the four measures of symptom distress. Bar graphs and descriptive statistics are presented for the nine data collection times for the Symptom Distress Scale, the State Anxiety Inventory for Children, the single item indicator for nausea
and the single item indicator for vomiting. Table 2 summarizes when each of the data collection points occurred.

Table 2

<table>
<thead>
<tr>
<th>Data Collection Points</th>
<th>Time of Data Collection</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Pre treatment</td>
</tr>
<tr>
<td>Chemotherapy Treatment #</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

Symptom Distress Scale

Total mean SDS scores ranged from 16.0 to 24.0, with the highest SDS scores occurring during the three time measures for the first chemotherapy treatment. The lowest mean SDS score occurred immediately following the second chemotherapy treatment, after the use of the virtual reality intervention. A pattern emerged for each of the three chemotherapy treatments. Symptom Distress Scale scores were high prior to each chemotherapy treatment, dropped immediately following the chemotherapy treatment, and then rebounded again at the 48 hour post chemotherapy measure. Figure 4 illustrates the mean SDS scores over the nine time measures.
Figure 4:

Mean Scores for Symptom Distress Scale
State Anxiety Inventory for Children

Mean STAIC C-1 scores ranged from 29.2 to 34.8. The highest mean STAIC C-1 scores occurred prior to the first chemotherapy treatment and the lowest mean scores were recorded immediately following and 48 hours following the second chemotherapy treatment, when subjects used the virtual reality intervention. Figure 5 depicts the mean STAIC C-1 scores over the nine time measures.

Figure 5

Mean Scores for State Anxiety
Single Item Indicators: Nausea and Vomiting

For each of the nine time measures subjects were asked to rate their nausea and vomiting using visual analog scales with numerical anchors ranging from 1-5. Mean scores for both single item indicators were low. Mean ratings for nausea ranged from 1.2 to 2.1. Ratings for vomiting were even lower with mean scores ranging from 1.0 to 1.4. For several of the time points, the mean rating for vomiting was 1.0, indicating that none of the subjects experienced this symptom. Figures 6 and 7 portray the mean responses to the single item indicators.

Figure 6

Mean Scores for Single Item Indicator: Nausea

![Bar chart showing mean scores for nausea across three chemotherapy sessions.](image-url)
Symptom Distress Scale: Individual Items

The Symptom Distress Scale was used as a global indicator of symptom distress for this study. An advantage of this instrument was that it combined the subject's ratings of several different symptoms to produce an overall score. By examining the responses to the individual scale items it was possible to determine which symptoms were most distressful in this sample, and which symptoms were affected by the virtual reality distraction intervention. Table 3 provides the mean scores for each of the nine data collection points.

Symptoms causing the most distress in this sample of older children
receiving chemotherapy were fatigue, insomnia, and pain. Cough, appetite, and outlook were scored at least distressful. Mean scores were lowest for the time five data collection point, which measured symptom distress immediately following use of the virtual reality equipment. The virtual reality intervention was most effective in reducing distress related to fatigue, nausea, and pain. As expected the intervention did not influence appetite, bowel pattern, or insomnia.

**Table 3**

**Symptom Distress Scale: Mean Score of Individual Scale Items**
**for the Nine Data Collection Points**

<table>
<thead>
<tr>
<th>Scale Item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5*</th>
<th>6**</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Nausea (presence)</td>
<td>1.3</td>
<td>1.2</td>
<td>2.0</td>
<td>1.6</td>
<td>1.3</td>
<td>1.6</td>
<td>1.5</td>
<td>1.6</td>
<td>1.7</td>
</tr>
<tr>
<td>2 Nausea (intensity)</td>
<td>1.5</td>
<td>1.2</td>
<td>1.7</td>
<td>1.5</td>
<td>1.2</td>
<td>1.6</td>
<td>1.4</td>
<td>1.6</td>
<td>1.8</td>
</tr>
<tr>
<td>3 Appetite</td>
<td>1.2</td>
<td>1.2</td>
<td>1.6</td>
<td>1.1</td>
<td>1.1</td>
<td>1.4</td>
<td>1.4</td>
<td>1.4</td>
<td>1.6</td>
</tr>
<tr>
<td>4 Insomnia</td>
<td>2.6</td>
<td>2.6</td>
<td>2.3</td>
<td>1.8</td>
<td>1.8</td>
<td>1.6</td>
<td>1.7</td>
<td>1.7</td>
<td>1.6</td>
</tr>
<tr>
<td>5 Pain (presence)</td>
<td>2.4</td>
<td>1.6</td>
<td>1.9</td>
<td>1.6</td>
<td>1.3</td>
<td>1.5</td>
<td>1.8</td>
<td>1.4</td>
<td>1.7</td>
</tr>
<tr>
<td>6 Pain (intensity)</td>
<td>2.2</td>
<td>1.4</td>
<td>1.9</td>
<td>1.4</td>
<td>1.3</td>
<td>1.4</td>
<td>1.6</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>7 Fatigue</td>
<td>2.4</td>
<td>2.5</td>
<td>2.3</td>
<td>1.8</td>
<td>1.3</td>
<td>2.1</td>
<td>2.0</td>
<td>1.9</td>
<td>2.0</td>
</tr>
<tr>
<td>8 Bowel pattern</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
<td>1.4</td>
<td>1.4</td>
<td>1.4</td>
<td>1.6</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>9 Concentration</td>
<td>1.6</td>
<td>2.0</td>
<td>1.6</td>
<td>1.2</td>
<td>1.2</td>
<td>1.4</td>
<td>1.5</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>10 Appearance</td>
<td>1.7</td>
<td>1.6</td>
<td>1.6</td>
<td>1.3</td>
<td>1.2</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>11 Outlook</td>
<td>1.7</td>
<td>1.5</td>
<td>1.4</td>
<td>1.3</td>
<td>1.0</td>
<td>1.4</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>12 Breathing</td>
<td>2.4</td>
<td>1.6</td>
<td>1.7</td>
<td>1.6</td>
<td>1.1</td>
<td>1.1</td>
<td>1.6</td>
<td>1.6</td>
<td>1.4</td>
</tr>
<tr>
<td>13 Cough</td>
<td>1.5</td>
<td>1.6</td>
<td>1.3</td>
<td>1.3</td>
<td>1.0</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* Mean SDS scores immediately following chemotherapy treatment two, when the subjects used the virtual reality distraction intervention.
**Mean SDS scores 48 hours following chemotherapy treatment two, when the subjects used the virtual reality distraction intervention.
Analysis of Research Questions

The data analysis and results of the research questions will be presented in this section. The virtual reality distraction intervention was the independent variable. Symptom distress was the dependent variable and was measured by the Symptom Distress Scale (SDS), the State-Trait Anxiety Inventory for Children (STAIC C-1) and single item indicators for nausea and vomiting. Repeated Measures Analysis of Variance (RM-ANOVA) was used to answer both research questions.

As discussed in chapter III, a significance level of .10 was selected for hypothesis testing, based on an analysis of the risks and benefits of a type I versus a type II error (Lipsey, 1990). Relaxing the criterion for significance to a .10 level increases the risk of falsely rejecting the null, when the intervention was in fact not effective, was judged a lesser risk in this study than falsely accepting the null, discrediting an effective intervention. Hand and Taylor (1987) stated that when a study has a limited number of subjects, it was preferable to carry out statistical tests at a very lax type I error level. They suggest an alpha of .20 for pilot and exploratory studies.

Testing of Assumptions for Repeated Measures ANOVA

The assumptions of univariate repeated measures ANOVA are: 1. For
all subjects, the spacing of measures must be the same. 2. There should be an equal number of observations for each subject. 3. All the observations within each factor level must be independent. 4. Multivariate normality and 5. Variance-covariance assumptions. (Shott, 1990; Sidani & Lynn, 1993). Shott (1990) states that random sampling is not crucial for one-factor repeated measures ANOVA testing.

The study design meets the criteria for assumptions one through three. Prior to data analysis, the investigator verified normality by examining histograms of each factor level for all measures of symptom distress. Histograms for each factor level of the SDS and the STAIC C-1 were consistent with sampling from normal populations. However histograms from the single item indicators of nausea and vomiting were not normally distributed. Possible responses ranged from one to five, but there was not enough variability in the actual responses. Most subjects rated their nausea and vomiting as a one across all time points. The histograms demonstrated a definite positive skew. The assumption of normality for the independent indicators of nausea and vomiting was not met and repeated measures testing could not be performed on this data. Shott (1990) states that repeated-measures ANOVA cannot be done when the data have only a few possible values. As a result, the only measures of symptom distress that could be used for hypothesis testing were the SDS and the STAIC C-1.
For each repeated measures ANOVA test, Mauchly’s test was calculated. If the p-value of Mauchly’s test was greater than or equal to the alpha (.10), it was assumed that the variance-covariance assumptions are reasonable for the data (Shott, 1990). The value for Mauchly’s test is provided for each repeated measures ANOVA test.

**Hypotheses Testing**

**Research Question 1**

Q(1) Will general symptom distress levels be lower in children with cancer who receive a virtual reality distraction intervention during a chemotherapy treatment as compared with symptom distress levels in the same children during the chemotherapy treatment prior to, and following the use of the virtual reality distraction intervention?

H (1) There will be differences in measures of symptom distress immediately following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

Repeated-measures ANOVA was used to compare Symptom Distress Scale responses immediately following the three chemotherapy treatments.
Subjects received the virtual reality distraction intervention during the second chemotherapy treatment. The p value for Mauchly's test was .89 so the variance-covariance assumptions were reasonable for the data. Results indicated that there was a difference in the Symptom Distress Scale over the three time measures (F= 3.30, 2 and 20 df, p = .06). The hypothesis was supported. Table 4 shows the descriptive statistics for the SDS and Table 5 shows the repeated measures analysis.

**Table 4**

**Descriptive Statistics: Immediately Post Chemotherapy SDS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>STD DEV</th>
<th>Min</th>
<th>Max</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDS 2</td>
<td>21.3</td>
<td>7.51</td>
<td>13.00</td>
<td>35.00</td>
<td>11</td>
</tr>
<tr>
<td>SDS 5</td>
<td>16.0</td>
<td>2.86</td>
<td>13.00</td>
<td>21.00</td>
<td>11</td>
</tr>
<tr>
<td>SDS 8</td>
<td>19.5</td>
<td>9.34</td>
<td>13.00</td>
<td>44.00</td>
<td>11</td>
</tr>
</tbody>
</table>

**Table 5**

**RM-ANOVA Immediately Following Chemotherapy SDS**

Mauchly sphericity test, W = .97
Significance = .89

<table>
<thead>
<tr>
<th>Source of Var.</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Sig F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within + Residual</td>
<td>478.18</td>
<td>20</td>
<td>23.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post Chemo SDS</td>
<td>157.82</td>
<td>2</td>
<td>78.91</td>
<td>3.30</td>
<td>.06</td>
</tr>
</tbody>
</table>
Post hoc analysis was done using paired t-tests to determine at which time point the SDS measure was different. A graphic representation of SDS scores follows in Figure 8 and Table 6 shows the paired T-test comparison of SDS scores immediately following chemotherapy. A significant difference exists between SDS scores \( p=0.02 \) on the first and second chemotherapy treatment. Data Analysis supports the notion that general symptom distress levels are lower in children with cancer who receive a virtual reality distraction intervention during a second chemotherapy treatment as compared with symptom distress levels in the same children during the first chemotherapy treatment when they do not receive the virtual reality intervention.

**Figure 8**

**Mean Symptom Distress Scores Immediately Following Chemotherapy**
Table 6

**Post Hoc Analysis for Comparison of SDS Scores Immediately Following Chemotherapy**

<table>
<thead>
<tr>
<th>Paired t-test</th>
<th>t-value</th>
<th>df</th>
<th>significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemo 1 and Chemo 2</td>
<td>2.68</td>
<td>10</td>
<td>.02</td>
</tr>
<tr>
<td>Chemo 2 and Chemo 3</td>
<td>-1.54</td>
<td>10</td>
<td>.16</td>
</tr>
<tr>
<td>Chemo 1 and Chemo 3</td>
<td>.90</td>
<td>10</td>
<td>.39</td>
</tr>
</tbody>
</table>

Repeated-measures ANOVA was used to compare state anxiety score immediately following the chemotherapy treatments one, two and three. Again, subjects received the virtual reality distraction intervention only during the second chemotherapy treatment. The p value for Mauchly's test was .96 so the variance-covariance assumptions were reasonable for the data. Results indicated that there was no difference in the STAIC C-1 over the three time measures (F= 2.47, 2 and 20 df, p =.11). The first hypothesis could not be supported by these results. Comparing differences in state anxiety, as a specific measure of symptom distress, did not demonstrate that mean scores were lower when subjects used the virtual reality intervention. Tables 7 and 8 show the descriptive statistics and the repeated measures analysis of the state anxiety scores immediately post chemotherapy.
Table 7

**Descriptive Statistics: Immediately Post Chemotherapy STAIC C-1**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>STD DEV</th>
<th>Min</th>
<th>Max</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAIC-1 2</td>
<td>32.5</td>
<td>4.03</td>
<td>29.00</td>
<td>41.00</td>
<td>11</td>
</tr>
<tr>
<td>STAIC-1 5</td>
<td>29.2</td>
<td>5.23</td>
<td>20.00</td>
<td>39.00</td>
<td>11</td>
</tr>
<tr>
<td>STAIC-1 8</td>
<td>29.9</td>
<td>6.33</td>
<td>20.00</td>
<td>37.00</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 8

**RM-ANOVA Immediately Following Chemotherapy STAIC C-1**

Mauchly sphericity test, $W = .99$
Significance = .96

<table>
<thead>
<tr>
<th>Source of Var.</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Sig F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within + Residual</td>
<td>263.03</td>
<td>20</td>
<td>13.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post Chemo STAIC C-1</td>
<td>64.97</td>
<td>2</td>
<td>32.48</td>
<td>2.47</td>
<td>.11</td>
</tr>
</tbody>
</table>

Research Question 2

Q(2) Does the virtual reality intervention have a lasting effect on children that is capable of mitigating chemotherapy related symptoms over time?

H (2) There will be differences in measures of symptom distress two days following chemotherapy treatments, over three time measures in a
single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

Repeated-measures ANOVA was used to compare Symptom Distress Scale responses obtained 48 hours after chemotherapy treatments one, two and three. Any significant lasting effects from the virtual reality distraction intervention would be reflected in a different SDS score for the second chemotherapy treatment. The variance-covariance assumptions are reasonable for the data because the p value for Mauchly's test is .67. Results indicated that there was no difference in the Symptom Distress Scale over the three time measures (F = 1.83, 2 and 20 df, p = .19). The hypothesis could not be supported. Tables 9 and 10 present the 48 hour post Symptom Distress Scale results.

Table 9

**Descriptive Statistics: 48 Hours Post Chemotherapy SDS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>STD DEV</th>
<th>Min</th>
<th>Max</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDS 3</td>
<td>23.1</td>
<td>9.34</td>
<td>15.00</td>
<td>41.00</td>
<td>11</td>
</tr>
<tr>
<td>SDS 6</td>
<td>18.8</td>
<td>5.29</td>
<td>13.00</td>
<td>29.00</td>
<td>11</td>
</tr>
<tr>
<td>SDS 9</td>
<td>20.3</td>
<td>10.71</td>
<td>13.00</td>
<td>49.00</td>
<td>11</td>
</tr>
</tbody>
</table>
Table 10

**RM-ANOVA 48 Hours Following Chemotherapy SDS**

Mauchly sphericity test, W = .91  
Significance = .67

<table>
<thead>
<tr>
<th>Source of Var.</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Sig F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within + Residual</td>
<td>568.18</td>
<td>20</td>
<td>28.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48 hr Post Chemo SDS</td>
<td>103.82</td>
<td>2</td>
<td>51.91</td>
<td>1.83</td>
<td>.19</td>
</tr>
</tbody>
</table>

State Anxiety responses obtained 48 hours after chemotherapy treatments one, two and three were also analyzed using repeated-measures ANOVA. Again, any lasting effects from the virtual reality distraction intervention would be reflected in a different STAIC C-1 score for the second chemotherapy treatment. The p value for Mauchly’s test was .88 so the variance-covariance assumptions were not violated. Results indicated that there was a difference in the STAIC C-1 over the three time measures (F = 3.51, 2 and 20 df, p = .07). Table 11 depicts the descriptive statistics for the 48 hours post chemotherapy STAIC C-1 and Table 12 shows the repeated measures analysis.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>STD DEV</th>
<th>Min</th>
<th>Max</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAIC C-1</td>
<td>33.3</td>
<td>4.96</td>
<td>25.00</td>
<td>41.00</td>
<td>11</td>
</tr>
<tr>
<td>STAIC C-1</td>
<td>29.5</td>
<td>5.18</td>
<td>20.00</td>
<td>39.00</td>
<td>11</td>
</tr>
<tr>
<td>STAIC C-1</td>
<td>30.6</td>
<td>6.39</td>
<td>20.00</td>
<td>38.00</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 12

**RM-ANOVA 48 Hours Following Chemotherapy STAIC C-1**

Mauchly sphericity test, W = .97  
Significance = .88

<table>
<thead>
<tr>
<th>Source of Var.</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Sig F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within + Residual</td>
<td>276.61</td>
<td>20</td>
<td>13.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48 hr Post Chemo STAIC C-1</td>
<td>84.06</td>
<td>2</td>
<td>42.03</td>
<td>3.04</td>
<td>.07</td>
</tr>
</tbody>
</table>

Post hoc analysis was done using paired t-tests to determine at which time point the STAIC C-1 measure was different. A significant difference exists between STAIC C-1 scores (p = .04) on the first and second chemotherapy treatment (Table 13). The hypothesis was supported that a difference in means scores exists. Figure 9 depicts that state anxiety levels were higher in children with cancer during the first chemotherapy treatment.
as compared with state anxiety levels in the same children during the second and third chemotherapy treatments.

Figure 9

Mean STAIC C-1 Scores 48 Hours Following Chemotherapy Treatment

Table 13

Post Hoc Analysis for Comparison of STAIC C-1 Scores 48 Hours Following Chemotherapy

<table>
<thead>
<tr>
<th>Paired t-test</th>
<th>t-value</th>
<th>df</th>
<th>significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemo 1 and Chemo 2</td>
<td>2.32</td>
<td>10</td>
<td>.04</td>
</tr>
<tr>
<td>Chemo 2 and Chemo 3</td>
<td>-0.81</td>
<td>10</td>
<td>.43</td>
</tr>
<tr>
<td>Chemo 1 and Chemo 3</td>
<td>1.59</td>
<td>10</td>
<td>.14</td>
</tr>
</tbody>
</table>
Secondary Analysis

A consistent pattern of chemotherapy related symptom distress was exhibited during all three chemotherapy treatments. Symptom distress levels for both the SDS and STAIC C-1 were high on the prechemotherapy measure, dropped immediately following the chemotherapy treatment, and increased again at the 48 hour post chemotherapy measure (refer to Figure 4).

Repeated-measures ANOVA were used to analyze the difference in the pre, post, and 48 hour post symptom distress measures obtained for each chemotherapy treatment. SDS and STAIC C-1 scores did not change significantly during chemotherapy treatment 1 and 3, when the subjects did not use the virtual reality intervention. There was a significant difference in scores for the SDS (p<.01) during chemotherapy two, when the subjects used the virtual reality treatment. Table 14 shows the results of the repeated-measures ANOVA for the three chemotherapy treatments.
Table 14

RM-ANOVA Comparison of Symptom Distress Measures Pre, Post and 48 hrs Post for each of the Three Chemotherapy Treatments

<table>
<thead>
<tr>
<th>Chemotherapy Treatment</th>
<th>Symptom Distress Measure</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SDS</td>
<td>2.09</td>
</tr>
<tr>
<td>1</td>
<td>STAIC C-1</td>
<td>2.46</td>
</tr>
<tr>
<td>2</td>
<td>SDS</td>
<td>6.12*</td>
</tr>
<tr>
<td>2</td>
<td>STAIC C-1</td>
<td>1.86</td>
</tr>
<tr>
<td>3</td>
<td>SDS</td>
<td>0.32</td>
</tr>
<tr>
<td>3</td>
<td>STAIC C-1</td>
<td>0.23</td>
</tr>
</tbody>
</table>

* p< .01  (df 2,20)   n=11

Post hoc analysis using paired t-tests show that the scores immediately post chemotherapy (after using the virtual reality intervention) were significantly different from both the pre chemotherapy measure and the 48 hour post chemotherapy measure. Table 15 shows the post hoc analysis and Figure 10 graphically represents the difference in mean SDS score for the second chemotherapy treatment.

Table 15

Post Hoc Analysis: Comparison of measures of Symptom Distress During the Second Chemotherapy treatment

<table>
<thead>
<tr>
<th>Paired t-test</th>
<th>t-value</th>
<th>df</th>
<th>2-tail Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDS Prechemo and Post Chemo</td>
<td>3.19</td>
<td>10</td>
<td>.01*</td>
</tr>
<tr>
<td>SDS Post Chemo and 48hr Post Chemo</td>
<td>-2.66</td>
<td>10</td>
<td>.02*</td>
</tr>
<tr>
<td>SDS Prechemo and 48hr Post Chemo</td>
<td>-0.11</td>
<td>10</td>
<td>.91</td>
</tr>
</tbody>
</table>
Figure 10

**Mean SDS Scores for the Second Chemotherapy Treatment with the Virtual Reality Intervention**

For each of the three chemotherapy treatments, there was a drop in SDS scores immediately following each chemotherapy treatment when compared with pre chemotherapy and 48 hour post chemotherapy measures. The secondary analysis demonstrated that the only time this change in scores was significant was during the second chemotherapy treatment, when the subjects used the virtual reality equipment. This secondary analysis supports the premise that the virtual reality distraction intervention helped to mitigate symptom distress during the second chemotherapy treatment. This will be discussed further in chapter five.
Qualitative Evaluation of Virtual Reality Intervention

Following completion of the virtual reality distraction intervention during chemotherapy two, all subjects filled out a subjective evaluation of the intervention. This evaluation was completed in addition to the standard measures of symptom distress. The evaluation form took approximately five minutes to complete and consisted of open ended questions concerning the virtual reality experience. The length of time the virtual reality distraction was used was recorded as a total amount of minutes with subtotals for each of the three possible virtual reality scenarios. In the following section, responses to the Evaluation of Virtual Reality Intervention Form are presented as descriptive statistics and comments from the subjects.

Length Of Time Spent Using The Virtual Reality Equipment

All subjects used the virtual reality distraction during their intravenous chemotherapy treatment. This amount of time ranged from 40 to 120 minutes (Mean = 65.00 min SD =21.45). Data were also collected regarding the amount of time subjects spent using the three different virtual reality scenarios (Table 16). Subjects were free to choose whichever scenario they wanted to use and could change scenarios if they wanted to during the session. Most subjects viewed two or more scenarios. Preferences for scenarios differed based on age. Younger subjects chose
Magic Carpet® more frequently, while Sherlock Holmes® was more likely to be used by older children. Seventh Guest® was most popular and appealed to all ages.

Table 16

**Time Spent Using Virtual Reality Scenarios**

<table>
<thead>
<tr>
<th>Virtual Reality Scenario</th>
<th># of Subjects</th>
<th>Range</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magic Carpet ®</td>
<td>6</td>
<td>10-70 min.</td>
<td>34.1</td>
</tr>
<tr>
<td>Seventh Guest ®</td>
<td>8</td>
<td>25-90 min.</td>
<td>46.2</td>
</tr>
<tr>
<td>Sherlock Holmes ®</td>
<td>6</td>
<td>10-60 min.</td>
<td>26.0</td>
</tr>
</tbody>
</table>

**Evaluation of Equipment**

Several questions addressed the physical qualities of the virtual reality equipment. All subjects (100%) indicated that they had no difficulty with hearing the sounds produced by the headset. Six subjects (55%) indicated that they had some trouble seeing visual images. Three (27%) subjects stated that the Magic Carpet® visuals were difficult to see. Other comments were more general and indicated that it was difficult to see detailed objects. One subject said that the equipment made their eyes tired. Six (55%) of subjects did not have any difficulty seeing the images. One of these subjects stated that the images were "cool and weird."

Subjects were asked: "Did they have any trouble using the headset?"
Nine subjects (82%) stated that there was no problem using the headset. One subject wrote that their glasses wouldn't stay in place and the other stated that they had "a little" trouble using the headset. Another evaluation question asked if the headset was comfortable. This question elicited a variety of responses. Five subjects (45%) indicated that the headset was comfortable, while the remaining six subjects (55%) disagreed. Comments included: "The nose was not comfortable," "A little heavy, but what do you expect?," "It sort of gave me a headache," "Not as comfortable as it could be," and "I wouldn't wear it to sleep."

Virtual Reality Sensations

Subjects were asked if they "felt any unusual sensations while using the headset." They also were asked to list these sensations. Four subjects (36%) responded that they did not experience any unusual sensations. Three subjects (27%) indicated that the equipment gave them a type of headache. One subject stated it was a "mild headache" and another called it a "sort of" headache. The remaining four subjects provided a variety of responses: "It was cool and it was like I was in another world," "Sort of dizzy during Magic Carpet," "A scary feeling from the haunted house," and "I felt like it took my mind off chemo and made me more at ease."

Another question asked if the subjects were able to concentrate on
other activities that were occurring in the treatment room. Six subjects (55%) indicated that they could concentrate on other things, while the remaining five subjects (45%) indicated that they had a limited ability to concentrate on other things. The written answers to this question included: "I was too busy looking at the virtual reality," "kind of," "Could hear people talking but not what they were saying," "I did not try to," "a little," and "Didn't know I was getting chemo. A big distraction, I didn't know what else was happening."

**Recommendations For Future Use Of Virtual Reality**

Two questions asked subjects for their suggestions about the types of images they would like to use in the headset and for improvements to the virtual reality equipment. There were very few responses to these questions. Responses about the images were "The ones that I saw were good," "Vampires in coffin," "Underwater or using ships, boats, fish," and "hunting or fishing scenario." The following suggestions were made regarding improving the equipment: "I think you should get one for every kid that is sick," "More comfortable headset," "A little more padding (headset)," "No, I rate this experience as a 10. I thank you for the opportunity," "There should be a built in pillow," and "The headset should block out all of your surroundings. Images should be more clear."
Evaluation of Overall Experience

Three questions were asked to capture the overall evaluation of the virtual reality experience. Subjects were asked "compared with your previous chemotherapy treatment when you did not use the virtual reality treatment, how did you feel about this treatment?" Nine (82%) subjects indicated that this treatment was better than previous treatments. Two subjects (18%) indicated that there was no difference and no subjects (0%) indicated that the virtual reality experience made them feel worse. Sample positive responses include: "The other treatment was not as good, I was bored," "It was better, I felt like I didn't even get the treatment," "I didn't worry as much," "Lot better, I usually have nausea with other treatments," "I sat still and did something, not just lay there," "I like it better," "Quicker treatment," "It was more like I didn't feel like I got my treatment." "I feel better this time. This treatment was lots better than the others," and "I thought it was easier."

All subjects (100%) responded positively when asked if they liked using the virtual reality during their chemotherapy treatment. There was also a consensus among all eleven (100%) participants that they would like to use the virtual reality equipment again during their chemotherapy treatment. One subject added an additional comment to the evaluation form "Good thing I got cancer, because now I get to play with this."
Summary

This chapter presented the study results. The sample was described. Primary and secondary data analyses for the two hypotheses were included. Descriptive statistics were used to summarize the Qualitative Evaluation of the Virtual Reality Intervention. A discussion of the findings follows in Chapter V.
Chapter V

SUMMARY, DISCUSSION AND RECOMMENDATIONS

Summary

The objective of this study was to test the premise that virtual reality, as a developmentally appropriate distraction intervention, could help to make chemotherapy treatments more tolerable for older children with cancer. By decreasing chemotherapy related symptom distress, the virtual reality intervention assists children to comply with prescribed treatment regimens, thereby enhancing their chances for cure.

Over two decades of research have supported the notion that distraction as a coping mechanism alleviated symptoms. There was a consensus that distraction interventions use an external stimulus to divert the focus of attention away from undesirable sensations. Descriptive studies demonstrated that distraction is a frequently used coping mechanism for both adults and children. Empirical studies tested a variety of distraction interventions such as relaxation, viewing a kaleidoscope, and video games. Results demonstrated that distraction relieved a variety of dependent variables including; pain, anxiety and nausea. Empirical studies testing the effectiveness of virtual reality have been limited. The majority of prior research has been limited to educational and surgical applications. This is the first study to date that explored the effectiveness of virtual reality as a
distraction intervention.

This study tested the effects of a virtual reality distraction intervention on symptom distress in older children receiving cancer chemotherapy. The specific research questions were:

(1) Will general symptom distress levels be lower in children with cancer who receive a virtual reality distraction intervention during a chemotherapy treatment as compared with symptom distress levels in the same children during the chemotherapy treatment prior to, and following the use of the virtual reality distraction intervention?

(2) Does the virtual reality intervention have a lasting effect on children that is capable of mitigating chemotherapy related symptoms over time?

An interrupted time series design with removed treatment was used to answer the research questions. Twelve subjects were recruited over 18 months from the outpatient pediatric population of the Ireland Cancer Center at University Hospitals of Cleveland. Data from 11 subjects were used for analysis.

Measures of symptoms distress were obtained at nine time points during three consecutive chemotherapy treatments. Four indicators were used to measure the dependent variable of symptom distress. The Symptom Distress Scale (SDS)(McCorkle, & Young, 1978) was considered a general
indicator. Specific indicators of symptom distress included the State-Trait Anxiety Inventory for Children (STAIC C-1) (Speilberger, 1970) and single item indicators for nausea and vomiting. Only data from the SDS and STAIC C-1 met the assumptions for statistical analysis. Internal consistency reliability coefficients for the SDS and STAIC C-1 were acceptable.

Repeated measures analysis of variance procedures were used to test the hypotheses. A significance level of .10 was selected for hypothesis testing. Data analysis of the SDS suggested that the virtual reality intervention was effective at reducing the level of symptom distress immediately following the chemotherapy treatment (p<.10), but did not have a lasting effect. Analysis of the STAIC C-1 demonstrated high levels of anxiety during the initial chemotherapy treatment which decreased during the two subsequent treatments. Anxiety levels were not affected by the virtual reality intervention.

Discussion

Sample Characteristics and Accrual

Twelve subjects were recruited for this study and accrual lasted eighteen months. Data from 11 subjects were used for analysis. The small sample was reasonable given the constraints of the study. The study required the recruitment of an uncommon population, older children with
cancer. Conducting the study on a local scale at a single site was appropriate given the investigator's experience and the fact that this was the first study which investigated the use of virtual reality as a distraction intervention.

Cancer in children is rare. An estimated total of 8,800 children will be diagnosed nationally in 1997 (American Cancer Society, 1997). The available population was further limited by the inclusion criteria. The children had to be old enough to complete the instruments, and had to be treated in the outpatient center. The latter criterion was established in order to control the dosage of the virtual reality intervention. Hospitalized children often receive continuous infusions of intravenous chemotherapy and it would not be possible to control the timing of the virtual reality intervention.

The two most prevalent childhood cancers treated on an outpatient basis are acute lymphocytic leukemia and hodgkins lymphoma. In the United States, the annual incidence rates of pediatric acute lymphocytic leukemia and hodgkins lymphoma are 1,600 and 750 respectively (American Cancer Society, 1997). It is estimated that Ohio accounts for 4.6% of all new cancer cases diagnosed nationally (Parker, Tong, Bolden, & Wingo, 1997). Assuming that only half of children diagnosed are old enough to complete questionnaires, the available population for this study in the state of Ohio was approximately 50.
The study site is one of the largest pediatric hospitals in the country and a major referral center for North East Ohio. This made it possible to recruit the twelve subjects. The investigator was extremely vigilant about subject identification. Weekly interdisciplinary meetings were attended and frequent phone calls were made to the outpatient pediatric clinic. All eligible subjects were approached to participate in the study and agreed to do so. Half way through the study, the investigator explored the possibility of using another study site. Addition of the next largest local pediatric treatment center would only yield another 2-3 subjects per year. Use of this additional site was rejected for feasibility reasons. It would have required approval from two additional institutional review boards. The necessary contacts to ensure recruitment and retention of the subjects had not been established, and only one set of virtual reality equipment was available.

While the sample was small, it was representative of the general population. The ages of the subjects were well distributed with a range from 10 to 17 years with a mean age of 14.0 (SD = 2.34). According to 1990 United States Census, whites account for approximately 84% of the national population, African Americans account for about 12% of the national population, and the remaining 4% is comprised of other groups such as Asian and Pacific Islanders, and Native Americans. There are Hispanics in every racial group (American Cancer Society, 1997). The sample used for
analysis was similar to the national statistics with Caucasian 8 (73%),
African American 2 (18%), and Arab-American 1 (9%).

All the subjects recruited were diagnosed with either acute
lymphocytic leukemia or hodgkins lymphoma. Of the subjects used for
analysis, seven subjects had a diagnosis of leukemia (64%) and four
subjects had a diagnosis of hodgkins lymphoma (36%). This is similar to
national figures, where the incidence of pediatric acute leukemia is
approximately twice that of hodgkins lymphoma (Parker, Tong, Bolden, &
Wingo, 1997). The incidence of acute lymphocytic leukemia is higher in
Whites that in Blacks (1.8 to 1) and higher among boys than girls (1.4 to 1)
(Pui, 1995). The ratios in this sample were caucasians to African Americans
(2.7 to 1) and males to females (1.4 to 1). The incidence of hodgkins
disease is equally distributed among the sexes (American Cancer Society,
1997). Fifty percent of the hodgkins lymphoma patients in this sample
where female and 50% were male.

Small samples are common in studies of older children with cancer.
Of the studies reviewed in Chapter 2, the largest sample size for older
children undergoing therapy for cancer was 15. Redd et al. (1987) tested
the effects of video game playing on nausea in 15 pediatric patients nine to
18 years of age. Weekes et al. (1993) compared a distraction intervention
in two populations of adolescents, ten with cancer and ten with renal

The two studies that had larger samples, Hinds & Martin (1988) (n = 58) and Tyc et al. (1995) (n = 57), were both conducted at St. Jude Children's Research Hospital. This center attracts children from all over the United States. Both studies employed broader inclusion criterion. The sample used by Hinds & Martin (1988) consisted of adolescents both on and off therapy. Tyc et al. (1995) examined children aged six to eighteen years who had completed chemotherapy treatment.

This study had a 100 percent participation rate. This rate is similar to other studies of older children with cancer. Tyc et al. (1995) reported that no one refused to participate. Enskar et al. (1997) reported that over 82% of possible identified subjects agreed to participate. Hinds, Weekes, and Zeltzer (1988) state that adolescents tend to view participation in research as a positive act. According to these authors, if the adolescent views their participation as meaningful and if confidentiality (even from parents) is assured, they are likely to participate.

In this study confidentiality was assured in the assent form and subjects verbalized that they liked to take part in something that could help
themselves or others. Several subjects who had completed data collection asked the investigator how the research was going and if it was helping other kids. It is possible that the study design enhanced the participation rate. In order to decrease the anxiety associated with the initial clinic visit, the procedure required the investigator to call the subjects and their parents in advance. The purpose of this call was to inform them that they would be asked to participate in a study and to give a very brief overview of the study to potential subjects and their parents. Since parents of older children rarely answer the phone, initial contact was often with the potential subject. This deterred parents from refusing to allow their child to participate before the potential subject had a chance to know about the study.

The post hoc effect size for this study, based on sample size of eleven, calculated by the SPSS program was .42. With this effect size and an alpha of .10, the statistical power for this study was .70. For this study there was a 70% probability that statistical significance would be attained given that there really was a treatment effect (Lipsey, 1990).

Findings: Answers to Research Questions

This study sought to answer two questions: did the virtual reality distraction intervention decrease symptom distress levels in older children during chemotherapy treatments? and does the virtual reality intervention
have a lasting effect? Results of the data analysis demonstrated that virtual reality as a distraction intervention could decrease symptom distress during chemotherapy treatments. Further study is needed to determine if the intervention has a lasting effect.

The first hypothesis tested was: There will be differences in measures of symptom distress immediately following chemotherapy treatments, over three time measures in a single group of children with cancer who receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

The repeated measures ANOVA of the two measures of symptom distress provided conflicting results. Analysis of the SDS, the global indicator for symptom distress, demonstrated that SDS values were significantly lower (p<.10) immediately following the chemotherapy treatment when the subjects used the virtual reality intervention. Analysis of the STAIC C-1, considered a specific indicator of symptom distress, demonstrated a different pattern and did not support the hypothesis. The STAIC C-1 values, immediately following chemotherapy treatment, were highest during the initial chemotherapy treatment when compared with values for the remaining two chemotherapy treatments. These differences were not significant.
The first hypothesis could be supported based on SDS data, but not based on STAIC C-1 data. It may not have been appropriate to conceptualize state anxiety as a specific indicator of symptom distress. State anxiety may be a separate phenomenon. Clinical observations support the notion that subjects are very anxious prior to the initial chemotherapy treatment. Once they have experienced the clinical setting, the chemotherapy treatment, and the expected side effects, the fear of the unknown is reduced. Subjects who were anxious prior to chemotherapy treatments often seemed relieved when it was over. It is also possible that the quality of the distractor was not conducive to decreasing anxiety. It is reasonable to expect distractors such as music or relaxation to decrease anxiety, but virtual reality may not produce the same effect. This distractor stimulated the senses and involved participants in challenging scenarios.

A pattern emerged over all three chemotherapy treatments. Refer to Figures 4 and 5 in Chapter IV. SDS values and STAIC C-1 values were high prior to chemotherapy administration, dropped immediately following chemotherapy treatment, and rebounded at the 48 hour post chemotherapy measure. Several possible explanations exist for this occurrence. The subjects may have felt relieved that the treatment was completed. Another plausible explanation is that untoward symptoms were effectively being managed while in the clinic. All subjects received ondansetron, a newly
developed antiemetic agent. This medication is highly effective and may account for the low levels of nausea and vomiting in this sample. This effective management of symptoms may have made it more difficult to determine the usefulness of the virtual reality intervention. The overall low levels of symptom distress contributed to a moderate effect size of .42 for the virtual reality intervention.

The pattern in symptoms mentioned above prompted a secondary analysis. The SDS scores for each of the three chemotherapy treatments were compared using separate repeated measures ANOVA procedures. No differences were found between the prechemotherapy, the immediately post chemotherapy and the 48 hour post chemotherapy values for either the first or third chemotherapy treatment. A difference was found for the second chemotherapy treatment when the subjects used the virtual reality intervention. SDS values immediately following the administration of chemotherapy were significantly lower (p < .01) than the prechemotherapy and post chemotherapy values. This finding lends support for the effectiveness of the distraction intervention during chemotherapy administration.

The second hypothesis tested was: There will be differences in measures of symptom distress two days following chemotherapy treatments, over three time measures in a single group of children with cancer who
receive a virtual reality distraction intervention during the second chemotherapy treatment and who receive no virtual reality intervention during the first and third chemotherapy treatments.

This hypothesis could not be supported based on the repeated measures ANOVA analysis of the SDS. SDS values were lower for the 48 hour post chemotherapy measure for the treatment when the subjects used the virtual reality treatment, but this difference was not significant. The STAIC C-1 values were significantly different (p<.10). Like the previous analysis, post hoc testing indicated that state anxiety values for the first chemotherapy treatment (without the virtual reality intervention) were higher than the two subsequent chemotherapy treatments. This study does not support the notion that distraction interventions have a lasting effect. Based on the small sample size and the low power for this analysis (.47), the question warrants further research.

Qualitative Evaluation of the Virtual Reality Intervention

Responses to the subjective evaluation of the virtual reality intervention suggest that the intervention was well received. Subjects made suggestions that can be used for future studies. The following section summarizes the subjective data from study participants and presents
researcher impressions regarding the feasibility of the intervention.

All subjects used the virtual reality equipment during their second chemotherapy treatment. The time using the equipment ranged from 40 - 120 minutes (Mean = 65.00, SD = 21.45). No subjects removed the equipment prior to the completion of their treatment. Subjects were free to choose which scenario they wanted to use and could change scenarios whenever they wanted.

The most popular scenario was Seventh Guest®. In this scenario participants move around in a haunted mansion solving mystery puzzles in each room. Subjects used this scenario an average of 46.25 minutes as compared with Magic Carpet® (34.12 minutes) and Sherlock Holmes® (26.00 minutes). Several factors about this scenario appealed to the subjects. It was easy to use, required very little instruction, and the graphics were easy to see. In addition, this scenario did not require any reading. A few subjects indicated that the graphics for the Magic Carpet® were difficult to see. In general Magic Carpet® was chosen by the younger children and Sherlock Holmes® was selected by the older children. Seventh Guest® appealed to all age groups.

Prior to beginning this study, the investigator reviewed several different commercially available software scenarios for the virtual reality equipment. At that time it was difficult to find scenarios that were
developmentally appropriate for 10-17 year olds. Much of the software reviewed contained violence or sexual content. The investigator chose scenarios that did not contain sexual situations, were nonviolent, and were not likely to produce motion sickness (i.e., roller coaster). All suitable scenarios were pilot tested on healthy children. The three scenarios rated as most interesting and easiest to use by the healthy children were selected for this study. Future studies could take advantage of the improved software that has become available since initiation of this research. Some suggestions include; underwater scenarios, nature scenes, and piloting an airplane.

The virtual reality headset chosen for this study was produced by the Virtual i-O company. Only a few headsets were commercially available at the initiation of the research. This headset was chosen because it was lightweight (8 ounces) and had the best graphics. Another feature of this headset was that it did not totally cover the patient's head. This requirement was essential because the patients needed to be monitored during therapy. One consultant suggested using a more open headset so that children didn't feel claustrophobic or sense a loss of control, an important factor to adolescents. After selecting the equipment, the investigator wrote the company requesting use of a headset. A headset was donated by the Virtual i-O company for this research.
Most subjects (82%) did not have any trouble using the headset and all the subjects reported that the audio component was satisfactory. However, 55% of subjects found the headset uncomfortable. Three subjects (27%) indicated that the headset gave them a headache. A factor which might have contributed to this discomfort was alopecia. While the headset contained padding, often there was a red pressure mark on the subject's scalp when the headset was removed. None of the eleven healthy children (with hair), who pilot tested the equipment, complained of headache.

Some subjects in both the pilot group and the research sample verbalized that they would prefer a more enclosed headset. Subjects were asked if they could concentrate on other things in the treatment room while they were using the virtual reality equipment. Six subjects (55%) indicated that they could, but many of them prefaced their response with "if I wanted to." The other five subjects (45%) responded that they could not. These responses, in addition to the fact that none of the subjects chose to remove the equipment prior to completion on chemotherapy suggest that the virtual reality was a distractor. The virtual reality experience met the definition of distraction, "the purposeful focusing of attention away from undesirable sensations" (Mobily et al., 1993, p. 542).

Different equipment may be used for future studies. A more enclosed headset could divert the focus of attention more effectively. Also
to promote comfort, subjects with alopecia should wear a scarf or head covering under the headset. This study used a personal computer on a portable cart to run the software. This allowed parents to visualize the scenarios on the computer screen. Parents seemed pleased that their children were pleasantly occupied and appeared not to be concerned with the content of the virtual reality. They often left the room to take care of insurance paperwork or get coffee. A lap top computer may make the system more portable and would take up less space in the treatment room.

The intervention was easy to administer and well received. It took less than five minutes to set up the equipment. One subject who used the virtual reality several times after participating in the study, was able to set it up himself. The overall evaluation of this intervention was positive. Nine subjects (82%) indicated the chemotherapy treatment with the virtual reality was better than previous treatments. The virtual reality intervention did not make any subjects feel worse during chemotherapy. All subjects indicated that they liked the virtual reality intervention and that they would like to use the equipment again.

In summary, the virtual reality distraction intervention was feasible to implement and positively accepted by the subjects. The intervention did help to make cancer chemotherapy treatments more tolerable for older children. Minor equipment adjustments could improve the effectiveness of
the virtual reality intervention.

**Comparison to Previous Research**

This study examined the use of a virtual reality distraction intervention using both subjective responses and quantitative measures. The findings of this study were consistent with previous research which tested distraction interventions. Results from this study will be compared with those of earlier research.

**Symptom Distress: Symptom Distress Scale**

Symptom distress levels for this sample and for a sample studied by Hinds of older children with cancer were lower than the values reported in previous studies with adult samples. The mean SDS scores for this sample during chemotherapy treatments one and three without the virtual reality intervention ranged from 19.6 to 24.0. The range of possible scores for the SDS was 13 to 65. In a sample of adolescents with cancer Hinds reported mean scale scores on the SDS ranging from 18.3 to 21.0 (personal communication, March, 1994).

Findings in adult populations indicate higher SDS scores. Sarna et al. (1993) used the SDS to measure symptom distress in adults with lung cancer. These researchers administered the SDS five times during the eight months following radiation therapy. Mean SDS scores for this sample
ranged from 22.0 to 25.6. Ehlke (1988) obtained a mean score of 23.5 on the SDS in a sample of 107 women receiving outpatient chemotherapy for breast cancer. McCorkle & Quint-Benoliel (1983) reported mean SDS scores of 26.7 and 26.1 in lung cancer patients who were interviewed one and two months post diagnosis.

It is possible to hypothesize several reasons why SDS scores were different for older children. This study employed a sample of children diagnosed with acute lymphocytic leukemia and hodgkins lymphoma. The prognosis for these diagnoses is better than the prognosis for lung cancer. Children may perceive their symptoms differently than adults. The recent advances in antiemetic medications may be responsible for the lower SDS scores in this sample. As a comparison, the mean scores on the SDS obtained from the sample of eleven healthy children used to pilot the questionnaires and virtual reality equipment was 17.1.

**Symptom Distress: State Anxiety**

The STAIC C-1 had not been used in children undergoing cancer chemotherapy treatment. Speilberger (1970) provided normative information for a sample of 1554 healthy children in grades four through six. For this sample mean STAIC C-1 scores for males was 31.0 and for females was 30.7. Mean state anxiety scores for the research sample during chemotherapy treatments one and three without the virtual reality
equipment ranged from 29.6 to 34.8. The highest STAIC C-1 scores were obtained immediately prior to the first chemotherapy treatment. State anxiety scores for this sample were slightly higher than the normative scores.

**Distraction Research**

The quantitative and qualitative findings from this study are consistent with the findings of previous researchers. Descriptive and qualitative studies (Hinds & Martin, 1988; Weekes & Kagan, 1994; Tyc et al., 1995; Enskar et al., 1997) all document that older children use distraction as an intervention to manage the side effects associated with cancer and chemotherapy treatment. Responses from the subjective evaluation of the virtual reality intervention support the findings of previous researchers. The majority of subjects (82%) stated that they felt better during the chemotherapy treatment when they used the virtual reality distraction. All of the subjects wanted to use the intervention again during their chemotherapy treatment and none of the subjects discontinued use of the virtual reality equipment prior to the completion of their chemotherapy treatment.

The literature review in Chapter II demonstrated that distraction interventions are effective at relieving symptoms in clinical populations. This is the first study that tests the effectiveness of virtual reality as a distraction intervention. Findings are similar to those of other researchers who
compared the effectiveness of a distraction interventions with no intervention (Flaherty & Fitzpatrick, 1978; Binnings 1987; Levin et al., 1987; Gaberson, 1991; Miller et al., 1992; French et al., 1994; Vessey et al., 1994, Pederson 1995). The effect size of the virtual reality intervention in this study was .42. This is smaller than the effect sizes reported in previous research ranging from .70 to .95 (Flaherty & Fitzpatrick, 1978; Gaberson, 1991; Vessey et al., 1994).

Redd et al.,(1987) tested the effectiveness of video games as distraction in a sample of children receiving chemotherapy. This study was similar in design, population, and distraction intervention to the current study. The decrease in physical symptom distress measured by the SDS following the virtual reality intervention is congruent with the significant decrease in nausea, as a result of video game playing, in the sample of 9 to 18 year olds studied by Redd et al., (1987). These researchers also measured anxiety using a visual analog scale, but found that the distraction produced no significant changes in anxiety scores. Broome et al., (1992) also failed to find a change anxiety ratings in a population of pediatric patients who practiced distraction during lumbar punctures.

Virtual Reality Research

This study added to the body of knowledge regarding virtual reality by exploring its potential as a distraction intervention. Researchers are
exploring the effectiveness of virtual reality for physical therapy (LeFevre, 1994; Dutton 1992; Kuhlen & Dohle, 1995), for anxiety disorders (Rothbaum et al., 1995; Salyer, 1997) and for surgery (Satava, 1995). Using virtual reality as a distraction intervention is just one more way to use this new technology to promote health and enhance quality of life.

A unique aspect of this study was that symptom distress was monitored while individuals were using the virtual reality equipment. A gap in virtual reality literature is that authors neglect to mention any adverse reactions (Strauss, 1995). In this study, three subjects experienced headaches while using the virtual reality equipment. This could be a result of binocular stress, similar to that reported by Mon-Williams et al. (1993). The headaches were relieved after the subjects removed the equipment and did not require treatment. The mean SDS scores and STAIC C-1 scores did not increase while subjects were using the virtual reality intervention. The fact that the virtual reality intervention did not increase symptom distress is an important finding.

Support for Theoretical Framework

The findings of this research lend support for the organizing framework described in Chapter I. The study used a synthesis of Lazarus and Folkman's (1984) stress and coping model and Hinds and Martin's
(1988) model of the self-sustaining process. The specific premise that this study tested was that distraction as an emotion-focused coping strategy mitigates perceptions of symptom distress.

In this study use of the virtual reality distraction intervention prompted a decrease in symptom distress as measured by the SDS. Subjects viewed the chemotherapy treatment as a threatening condition. This can be supported by the high scores obtained for the SDS and the STAIC C-1 prior to chemotherapy treatments. Emotion-focused coping is used when individuals perceive that nothing can be done to change the threatening condition. The virtual reality distraction was viewed as a type of emotion-focused coping since chemotherapy treatments are necessary for cure.

The subjective evaluation of the virtual reality intervention demonstrated that the children concentrated on the virtual reality and not on the administration of chemotherapy. This is consistent with Hinds and Martin's (1988) definition of distraction; "cognitive/behavioral activities that promote concentration on neutral or positive thought and conditions" (p. 337).

Hinds and Martin postulate that distraction leads to cognitive comfort. Cognitive comfort can be characterized by feelings of hopefulness and forgetting cancer. The model further postulates that cognitive comfort leads to adaptation to symptoms. It was assumed that cognitive comfort was
achieved during the virtual reality intervention. This assumption can be supported by subjective responses that indicated that 82% of children believed the chemotherapy treatment with the virtual reality intervention was better than previous chemotherapy treatments. Several children commented, "I felt like I didn't even get the treatment".

Finally, data from the SDS supported a decrease in symptom distress during the chemotherapy treatment in which the children used the virtual reality distraction intervention. The SDS measures the individual's perceptions of the amount of distress associated with various symptoms. As the theoretical model predicted, the virtual reality intervention mitigated perceptions of symptom distress.

Limitations

Results of this research must be interpreted cautiously due to the use of a small convenience sample and a single study site. The single group interrupted time series design prevented the researcher from establishing causality. The generalizability of this study is limited to older children, who receive outpatient chemotherapy for cancer, are willing to volunteer for a study and to use virtual reality equipment.

The small convenience sample and single study site could contribute to a homogenous sample, which limits the researcher's ability to generalize
the findings. This threat to external validity was minimized because the study site is a regional referral site for children with cancer. Subjects represented a variety of demographic characteristics including age, gender, and ethnic identity. Demographic data was evaluated in order to compare the sample obtained with national statistics. One study conducted at several sites across the country could provide a larger sample and make it easier to generalize the findings.

The inclusion criteria did not specify the type of chemotherapeutic agents the children received. The types of chemotherapeutic were different depending on the type of cancer and particular treatment protocol in use. The different chemotherapy treatments had varying emetic levels. However, attempts were made to control for this potential confounding variable by matching the three chemotherapy treatments for each subject.

There was no way to predict previous exposure to or use of other distraction interventions, or to account for how effectively these interventions have been used in the past. It was not possible to control for alternative types of coping strategies the children used while enrolled in the study. Participants may have used other distraction interventions in addition to the virtual reality. Since the subjects served as their own control, it was assumed that the coping strategies used by each subject would remain constant over time.
There was a possibility of investigator bias in the measurement of outcomes or the application of the intervention. In order to decrease the chances of investigator bias, standard explanations were used for explaining the study prior to obtaining informed consent and for describing how to use the virtual reality equipment. Standard written instructions were provided at the top of all questionnaires. Future studies could involve implementation of the virtual reality intervention by several nurses at various settings across the country.

The purpose of using a time series design was to infer whether the treatment had an impact. This design does not allow the investigator to presume a causal relationship. With this design each person serves as their own control, eliminating the need for randomization to produce group equivalency. Posttreatment differences cannot be attributed to individual differences (Girden, 1992). In order to infer causality, future studies testing the virtual reality intervention should employ an experimental design.

The effects of practice and fatigue must be considered when using a time series design. Improvements could either be attributed to the treatment or the effects of practice. Similarly, a decline could be attributed to the treatment or fatigue. In this study, attempts were made to reduce the possibility of questionnaire fatigue by keeping the symptom distress measures brief. Subjects completed questionnaires in five to ten minutes.
and no attrition occurred. Since the measures of symptom distress were an inventory of symptoms, reflecting how subjects felt at a given point, practice effects did not apply to this study. Unlike competency testing, there was no incentive to get a better score than on previous measures.

Recommendations

The goal of this study was to determine the effectiveness of a virtual reality distraction intervention as a treatment for symptom distress in older children receiving cancer chemotherapy. There was supporting evidence that this intervention can reduce symptom distress in this population. Nursing is a practice discipline concerned with promoting health and enhancing quality of life. Historically, since the time of Florence Nightingale, nurses have manipulated the environment to promote health and healing (Shuyler, 1992). The findings of this study are of importance to the discipline and have implications for both clinical practice and future research.

Clinical Practice

The observed effect of the virtual reality intervention in this study supports its use in clinical practice with older children receiving cancer chemotherapy. The specific findings cannot be generalized to other
populations. Implementation of the virtual reality intervention is both feasible and cost effective.

Findings of this study support that the virtual reality distraction intervention does not require detailed instruction or practice or to be effective. Prior research has documented that nursing time and the need for prior practice are often barriers to the implementation of distraction interventions (Wolfe et al., 1987). Nurses need not be present while patients use the virtual reality intervention. In a brief session, subjects can be taught how to set up the equipment and then are free to use it as needed.

The cost of the virtual reality equipment including computer, software, and headset is approximately $2,000. This cost is reasonable, when considering several factors. The cost of a single dose of antiemetic medication is often $20.00 and children may receive 5 to 6 doses of antiemetic medication with each chemotherapy treatment. A considerable amount of money is already being spent on symptom management. The virtual reality intervention has an advantage. One set of equipment can be used several times by different children.

Since the virtual reality intervention did not increase symptom distress and, since only a few subjects reported transient headaches, which did not require treatment, there is support for use of this intervention in populations
with similar symptoms. Like other treatments, the intervention should be used with caution. Nurses and patients should be instructed to discontinue to virtual reality if the patient experiences and untoward reactions.

The findings of this study support the use of virtual reality as a feasible distraction intervention in the clinical setting. This technology can be viewed as a viable adjunct to standard treatment for management of symptom distress.

**Future Research**

A major objective of nursing research is to provide evidence for the effectiveness of nursing interventions. Nursing actions should be based on the scientific development of knowledge. Given the limitations of this study, there is a need for further investigation of the effects of virtual reality as a distraction intervention.

In order to infer causality in this population of older children undergoing cancer chemotherapy, a large scale study needs to be conducted using multiple study sites and an experimental design. Randomization of subjects into experimental and control groups is essential. Special attention should be given to the measurement of symptom distress and to monitoring any adverse effects of the virtual reality intervention. The study design should include a mechanism for measuring any possible lasting
effects of the intervention.

Future research needs to be designed and implemented which will explore the effects of the virtual reality intervention on different samples and using different dependent variables. This intervention may be effective for patients with varying diagnoses. Currently a study is being funded by the National Institutes of Health exploring the effectiveness of virtual reality on pain in burn patients (Salyer, 1997). Studies need to be conducted to test whether the intervention is more effective for certain age groups and if different distraction scenarios produce different outcomes. The influence of coping style and gender on the effectiveness of the virtual reality intervention should be explored.

Research had shown that psychological interventions alter physiologic functions. It is possible that the virtual reality distraction intervention may affect immune function. Future research could test the effects of virtual reality on physiologic measures such as immune function, heart rate, and blood pressure.

The effectiveness of virtual reality as a distraction intervention should be tested in comparison to other distractors. Research questions like, is virtual reality more effective than relaxation for certain types of individuals? need to be answered. Qualitative and quantitative research can help to develop predictive theory which predicts which type of distraction
interventions are appropriate for different individuals.

Clinical research on the effectiveness of distraction interventions is still in its early stages. This was the first study to suggest that virtual reality as a distraction intervention has positive clinical outcomes. Well designed, systematic intervention studies are critical to the development of nursing knowledge regarding distraction.
REFERENCES


Miller, S. M. (1980). When is a little knowledge is a dangerous thing? Coping with stressful events by monitoring vs. blunting. In S. Levine & H. Ursin (Eds.), *Coping and Health* (145-169). New York: Plenum Press.


Appendix A

UNIVERSITY of PENNSYLVANIA

Center for Advancing Care in Serious Illness

Ruth McCorkle, PhD, FAAN
Director
Barbara Lowsery, EdD, FAAN
Co-Director

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February 22, 1995

Susan M. Schneider, RN, MS, CS, OCN
Doctoral Student
Case Western Reserve University

Dear Ms. Schneider:

Thank you for your interest in my research. You have my permission to use the Symptom Distress Scale.

Your research sounds very interesting. I’ve enclosed a copy of the scale and some related articles. I’d appreciate a summary of your results when your study is completed.

If you have questions, please don’t hesitate to call. Good luck to you.

Sincerely,

Ruth McCorkle, PhD, FAAN
Professor

Enclosures

RM/erj
Symptom Distress Scale

Directions: Each of the following items lists 5 different numbered statements. Think about what each statement says, then place a circle around the one statement that most closely indicates how you have been feeling lately. Number 1 indicates no problems and number 5 indicates the maximum amount of problems. Numbers 2 through 4 indicate you feel somewhere in between these two extremes. Please circle only one number for each item.

1. Nausea
   1. I seldom if ever have nausea
   2. I have nausea once in a while
   3. I have nausea fairly often
   4. I have nausea half the time at least
   5. I have nausea almost continually

2. Nausea
   1. When I do have nausea, it is very mild
   2. When I do have nausea, it is mildly distressing
   3. When I have nausea, I feel pretty sick
   4. When I have nausea, I usually feel very sick
   5. When I have nausea, I am as sick as I could possibly be

3. Appetite
   1. I have my normal appetite and enjoy good food
   2. My appetite is usually, but not always, pretty good
   3. I don’t really enjoy my food
   4. I have to force myself to eat my food
   5. I cannot stand the thought of food

4. Insomnia (Trouble sleeping)
   1. I sleep as well as I always have
   2. I occasionally have trouble getting to sleep and staying asleep
   3. I frequently have trouble getting to sleep
   4. I have difficulty getting to sleep and staying asleep almost every night
   5. It is almost impossible for me to get a decent night’s sleep

5. Pain
   1. I almost never have pain
   2. I have pain once in a while
   3. I have pain several times a week
   4. I am usually in some degree of pain
   5. I am in some degree of pain almost constantly

6. Pain
   1. When I do have pain, it is very mild
   2. When I do have pain, it is mildly distressing
   3. When I do have pain, it is fairly intense
   4. The pain I have is very intense
   5. The pain I have is almost unbearable
7. Fatigue (Feeling weak or tired)
   1. I seldom feel tired or fatigued
   2. There are periods when I am rather tired or fatigued
   3. There are periods when I am quite tired and fatigued
   4. I am usually very tired and fatigued
   5. Most of the time, I feel exhausted

8. Bowel Pattern (Problems with Frequency or Pain During the Bowel Movement)
   1. I have my normal bowel pattern
   2. My bowel pattern occasionally causes me some discomfort or distress
   3. My present bowel pattern occasionally causes me considerable discomfort or distress
   4. I am usually in considerable discomfort or distress because of my present bowel pattern
   5. I am in almost constant discomfort or distress because of my present bowel pattern

9. Concentration
   1. I have my normal ability to concentrate
   2. I occasionally have trouble concentrating
   3. I occasionally have considerable trouble concentrating
   4. I usually have considerable trouble concentrating
   5. I just cannot seem to concentrate at all

10. Appearance
    1. My appearance has basically not changed
    2. Occasionally I am concerned about the worsening of my physical appearance
    3. I am often concerned that my appearance is worsening
    4. Most of the time I am concerned that my physical appearance is worsening
    5. The worsening of my physical appearance is a constant, pre-occupying concern

11. Breathing
    1. I usually breathe normally
    2. I occasionally have trouble breathing
    3. I often have trouble breathing
    4. I can hardly ever breathe as easily as I want
    5. I almost always have severe trouble with my breathing

12. Outlook
    1. I am not fearful or worried
    2. I am a little worried about things
    3. I am quite worried, but unfrightened
    4. I am worried and a little frightened about things
    5. I am worried and scared about things

13. Cough
    1. I seldom cough
    2. I have an occasional cough
    3. I often cough
    4. I often cough and occasionally have severe coughing spells
    5. I often have persistent and severe coughing spells

Total ________
Appendix B

MIND GARDEN
Sharing the Garden of the Mind

Date: Nov. 15, 1995

To whom it may concern,

This letter is to grant permission for Susan Schneider to use the following purchased copyright material:

Instrument: State-Trait Anxiety Inventory for Children
Author: Charles D. Spielberger

for her/his thesis. In addition, 5 sample items from the instrument may be reproduced for inclusion in a proposal or thesis. The entire measure may not at any time be included or reproduced in other published material.

Sincerely,

Anne Tucker

Director of Marketing and Customer Relations
Appendix C

Subject Identification Form

Date ________________

Name ____________________________

Diagnosis ____________________________

Chemotherapy

Type:


Dates  1 __________  2 __________  3 __________

Inclusion Criteria

____ Age 10-17
____ First diagnosis of cancer
____ Within the first 4 months of their initial chemotherapy treatment
____ Require at least 3 additional IV chemotherapy treatments
____ Able to read and write English
____ No clinical evidence of primary or metastatic disease to brain
____ No history of seizures
____ No history of motion sickness

Parents/guardian names ____________________________

Home telephone: ____________________________

Meeting time to discuss participation __________________

Agreed to participate?  ____ Yes  ____ No

If Yes, Identification number ____________

If No, Reason for not participating:
Appendix D

Data Collection Tool: Virtual Reality Study

Collect the following information from the patient record

1. Patient Name ____________________________ ID #: ______

2. Patient Age ______

3. Diagnosis (Type of Cancer - please circle)
   1. Leukemia
   2. Hodgkins Lymphoma
   3. Non-Hodgkins Lymphoma
   4. Sarcoma
   5. Other, please specify __________________

4. Sex  M / F

5. Chemotherapy Treatment:
   Protocol #: ________________
   List Agents and dosages

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Demographic Information and Use of Distraction

Now, some questions about you.

1. What is the last grade of school that you have finished? ________

2. What is your birthday? month ____ day ____ year ____

3. What is your racial or ethnic identification (please check one)
   __1. African-American or Black
   __2. Arab-American
   __3. Asian
   __4. Caucasian or White
   __5. Hispanic
   __6. Other, Please write in _______________________

4. When you are in a difficult situation, what kinds of things do you do to help you deal with the situation? (please check all items that apply)
   1. Think about happy things
   2. Think about the good things about the situation
   3. Read a book
   4. Look at pictures
   5. Take a nap or go to sleep
   6. Ask questions about the situation
   7. Watch television or a video
   8. Pray
   9. Hold a stuffed animal or doll
   10. Play a computer or video game
   11. Talk with friends about the situation
   12. Play a sport
   13. Eat or drink
   14. Spend time with another person
   15. Listen to music
   16. Get angry
   17. Get advice from someone
   18. Talk to parents

Are there any other things you do to deal with a difficult situation?

6. Have you ever had any experience using a virtual reality system?
   Yes ____ No ____

If yes, please indicate the type of system, how long you used it, where you used it, and how you felt about using the virtual reality.
1. Please indicate if you have used any medications in the past 48 hours to relieve pain.
   Yes ______ No ________
   If yes please write in the type of medication, the dose, and the times that you took this medication in the past 48 hours.

   Type of Medicine   Dose   Time

2. In the past 48 hours, I have had: (please circle the number that best describes how you feel)
   1  2  3  4  5
   No nausea
   Nausea as bad as it could be

3. In the past 48 hours, I have had: (please circle the number that best describes how you feel)
   1  2  3  4  5
   No vomiting
   Vomiting as bad as it could be

4. Please indicate if you have used any medications in the past 48 hours to relieve nausea or vomiting.
   Yes ______ No ________
   If yes please write in the type of medication, the dose, and the times that you took this medication in the past 48 hours.

   Type of Medicine   Dose   Time

5. Have you used any of the following in the last 48 hours? (please check all items that apply)
   _____ Nintendo
   _____ Sega
   _____ Computer games
   _____ Game boy
   _____ Virtual boy
   _____ Game gear
   _____ Sony play station

   Next to each item you used please indicate the start and stop times for when you used them in the last 48 hours.
6. In the last 48 hours what types of activities have you been able to do? (please check all items that apply)

   ___ Dress
   ___ Shower/bathe
   ___ Attend school
   ___ Watch television
   ___ Read
   ___ Participate in sports
   ___ Attend activities (band, school functions, scouts, church activities)
   ___ Other _________________________________
Evaluation of Virtual Reality Intervention

Subject ID

Date

How long did you use the Virtual Reality Equipment? _____ minutes

Which scenario did you use?
  1. Magic Carpet
  2. Sherlock Holmes (5)
  3. Seventh Guest
  4. Other ________________

When using the headset did you have any difficulty hearing the sounds that went with the scenario?

When using the headset did you have any difficulty seeing the images that went with the scenario?

Did you have any trouble using the headset?

Was the headset comfortable?

Did you experience any unusual sensations or feelings while using the headset? If yes, please list.

Do you have any suggestions for other types of images you would like to see with the headset?

Do you have any suggestions for how improve the use of the virtual reality equipment?
Were you able to concentrate on other activities that were occurring in the treatment room?

Compared with your previous chemotherapy treatment, when you did not use the virtual reality equipment, how did you feel about this treatment?

Did you like using the virtual reality equipment during your treatment?

Would you like to use the virtual reality equipment during your treatment again?
Appendix F

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UNIVERSITY HOSPITALS OF CLEVELAND
PATIENT CONSENT FOR INVESTIGATIONAL STUDIES

TITLE OF PROJECT:
Effects of Virtual Reality on Symptom Distress
in Children Receiving Cancer Chemotherapy

DESCRIPTION OF STUDIES:

I hereby give my consent for my child to take part in a study to help determine the
effect of a virtual reality intervention on symptoms in children receiving cancer
chemotherapy. I understand that my child’s physician has given approval for me to be
contacted regarding my child’s participation in this study.

I understand that my child’s medical record will be examined and that the following
information from the record will be collected for analysis: diagnosis, type of cancer
treatment, and types of medications received.

I understand that during three chemotherapy treatments, my child will be asked to
complete questionnaires to determine the type of symptoms they are experiencing and
their level of anxiety. I understand that the questionnaires will be completed prior to
each chemotherapy treatment, immediately following each chemotherapy treatment,
and via telephone at a prearranged time 48 hours after the completion of each
chemotherapy treatment. I understand that each questionnaire will be completed
nine times. I understand the questionnaires will take approximately 15-20 minutes to
comeplete each time.

I understand that during one of the three chemotherapy treatments, my child will use
virtual reality equipment while receiving the chemotherapy treatment. I understand
Virtual reality is a computer simulated technique which allows an individual to hear and
feel stimuli that correspond with a visual image. The individual wears an eight ounce
headset which projects a computer generated image with corresponding sounds. The
child is able to manipulate the image through use of a computer keyboard and mouse. I
understand that my child will be able to choose one of three scenarios to use while
receiving their intravenous chemotherapy. I understand that my child will receive all the
customary medical and nursing care while receiving their chemotherapy treatment and
using the virtual reality equipment. I understand that following use of the virtual reality
equipment my child will complete a one time questionnaire, which will be used to
evaluate the intervention. I understand this evaluation questionnaire will take 5-10
minutes to complete.

I understand that the risks involved for my child as a result of participating in this study
are possible fatigue and boredom related to completion of questionnaires. I understand
that my child may rest at any time during completion of the questionnaires.
UNIVERSITY HOSPITALS OF CLEVELAND
PATIENT CONSENT FOR INVESTIGATIONAL STUDIES

TITLE OF PROJECT:
Effects of Virtual Reality on Symptom Distress in Children Receiving Cancer Chemotherapy

DESCRIPTION OF STUDIES:
I understand that there are no known risks associated with use of the virtual reality equipment, but people could experience motion sickness or fatigue while using the headset, which could worsen chemotherapy related nausea. I understand that the virtual reality equipment may be uncomfortable to wear or that because of individual preferences, my child may not like the images presented by the equipment. I understand that my child may discontinue use of the virtual reality headset at anytime, by simply taking off the head set. I understand that should my child experience nausea they would be treated with their regularly prescribed antiemetics. I understand that a potential benefit of this study for my child is that use of virtual reality may be enjoyable and may make the chemotherapy treatment more tolerable. I understand it is possible that my child may feel better from participating in the study as a result of using the virtual reality during treatment.

I understand that my child’s participation in this study is completely voluntary and that I may withdraw my child from the study at any time. If I withdraw my child from the study, my child’s treatment will not be affected in any way. I understand that my child does not have to tell me his/her questionnaire answers and that the principal investigator will not share this information with parents.

I understand that all information will be recorded by code number and will be kept confidential. Any report of the study will include summary information only. I understand no one will be able to link my child with the information that they have provided.

I understand that there will be no extra costs charged to me as a result of my child’s participation in this study and I will only be responsible for the usual routine costs of my child’s treatment. I understand that I will not be financially compensated for my child’s participation in this project.

Signature_________________________ Age ___________ Date ____________

Parent or Guardian Signature (If subject is a minor)_______________________

Witnessed by ___________________________ Date _______________________

(Signature of Project Investigator)

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(5/69)
Appendix G

Effects of Virtual Reality on Symptom Distress in Children Receiving Cancer Chemotherapy

Assent Form for Study Participants Ages 10-17

I agree to be in a study. The study will see what effect using virtual reality has on symptoms of children taking cancer chemotherapy.

I know that facts about my treatment will be copied from my chart. I know that during three chemotherapy treatments, I will fill out forms about the symptoms I am having and my concerns. I know that the forms will be filled out just before each treatment, and right after each treatment, and by telephone two days after each treatment. I know that each form will be filled out nine times. I know the forms will take about 15-20 minutes to fill out each time.

I know that during one of my chemotherapy treatments, I will use virtual reality equipment. I know virtual reality is made by a computer and allows me to hear sounds that go with a picture. I will wear a light weight headset. I know I can move the picture with a computer keyboard and mouse. I know that I can choose from three programs. During my treatment, I will get all the usual medical and nursing care. When I am done, I will answer questions about the virtual reality equipment and programs. It will take 5-10 minutes to finish the questions.

I know that filling out the forms may make me tired or bored. I know that I may rest any time while filling out the forms. I know there are no known dangers from using the virtual reality equipment. Some people could get motion sickness or feel tired while using the headset. I know that these feelings could make the nausea from my chemotherapy worse. If this happens, I will get medicine for nausea. I know that the headset may not be comfortable to wear or that I may not like the pictures. I know that I may stop using the virtual reality at any time, by taking off the headset. I know that a good thing about this study is that the virtual reality may be fun to use and may make the chemotherapy treatment easier to take. I know that I may feel better because of using the virtual reality during treatment.

I know that my being in this study is my choice. I know I may quit the study any time. If I quit the study, my cancer treatment will be the same.

I know that all information will be kept very private. Any report of the study will include group information only. I know no one can link me with the answers that I have given. I know that I do not have to tell my parents what my answers were.

Name________________________ Date__________