IMPACT OF DAYLIGHT ON CHILDREN'S BEHAVIOR IN PEDIATRIC CLINIC WAITING ROOMS

A Dissertation

by

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ABSTRACT

Previous research has shown the stress-reduction effects of daylight, nature views, and other environmental factors among adult patients, however, limited research has been conducted on the stress-reducing effects of these factors on pediatric patients. The present study investigated the impact of daylight on children's behaviors in pediatric waiting rooms through an observational study of over 1,000 children's behaviors in a women and children's clinic and a pediatric dental clinic in Texas. The observations were conducted over a five-week period with a total of 223 thirty-minute observation sessions. Children's behaviors were observed and recorded with Noldus Observer® XT 10.5 behavioral mapping system during each session. Light levels, noise levels, and room temperature were also measured. Ten types of observed behaviors were categorized into negative behaviors (crying, shouting, hitting, fidgeting, getting out of their seats, and getting impatient and starting to talk to parents) and positive behaviors (laughing, running happily, singing, and speaking to oneself and making cute and funny sounds). Crying and singing were recorded by the duration of the occurrences in seconds. Other types of behaviors were recorded by the number of the occurrences.

Spearman's rho in SPSS 21 was used to test two primary hypotheses: 1) the presence of higher levels of daylight would result in a decreased number of negative behaviors and 2) the presence of higher levels of daylight would result in an increased number of positive behaviors. Additional analyses such as calculating seating preferences from seating maps and comparing behavior frequency between the two rooms were also measured and analyzed using Mann Whitney U test. The main results suggested that higher levels of daylight are associated with less negative behaviors and more positive behaviors. Additionally, the researcher found that patients preferred to sit closer to windows and an overly bright waiting room wasn't associated with better waiting experience.

The study expanded the knowledge of the impact of built environment on children's behaviors. The findings can be applied to future pediatric waiting room design. Future designs are suggested to promote access to natural light and nature views, to provide family space, to reduce glare and noise, and to adopt child-proof space design and finishing materials.

DEDICATION

To my supportive family and friends

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CHAPTER I

INTRODUCTION

1.1 STRESS IN HEALTHCARE ENVIRONMENT

Healthcare settings such as emergency departments and waiting areas are well-known to create stress and anxiety among patients and caregivers, as well as family members and visitors (Zimring, Joseph, & Choudhary, 2004; Ulrich, 1984). Stress-reduction was identified as an important issue in the field of healthcare design. Healing environments, which reduce stress levels and make patients and caregivers more relaxed, can not only promote healing outcomes but also improve caregiver performance and family and patient satisfaction (Dellinger, 2009). A well-designed healthcare environment should help reduce anxiety and create a more positive patient experience prior to and during a procedure. This is an important aspect of healthcare design on top of other important considerations such as providing functional spaces for medical treatments; protecting patient and staff safety; supporting physical, mental, and spiritual health (Carpman, Grant, & Simmons, 1993); and improving users' satisfaction.

In the nineteenth century, Florence Nightingale advocated the importance of direct sunlight, views of nature, and quiet environments to promote healing (Nightingale, 1960; Rubin, Owens, & Golden, 1998). Nightingale used descriptive data such as the incidences of preventable deaths to support her advocacy of hospital reform at that time (Cohen, 1984; Kopf, 1916). She might not have known that her theories/suggestions would later be supported by physicians and physicists' empirical findings. In terms of sunlight, it was found that the sunlight spectrum consists of rays, such as the ultra-violet ray, that has healing powers on skins diseases such as lupus and bone diseases such as rickets. Before long, heliotherapy was introduced (Holick, 1999). Sunlight has also been found to affect circadian rhythms, biological clocks, and sleep patterns; to trigger certain hormone release to help produce Vitamin D; and to uplift moods, prevent depression and improve seasonal disorders (Sassone-Corsi, Whitmore, Cermakian, & Foulkes, 1999; Boyce, 2003; Baum & Singer, 1987).

1.2 EVIDENCE-BASED DESIGN

Currently, the new vision and goal of healthcare design and research is to design and build better, safer, and more attractive healthcare settings, which not only provide specific functional spaces but also reduce stress and therefore promote healing. In recent decades, researchers and architectural practitioners have started using research evidence to assist in design decisions. This method is referred to as evidence-based design (EBD), first defined by Kirk Hamilton (2003, 2004) and later revised as "a process for the conscientious, explicit, and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project" (Stichler & Hamilton, 2008). EBD is also defined as "a process of basing decisions about the built environment on credible research to achieve best possible outcomes" by the Center for Health Design, non-profit organization that promote evidence-based design (2015).

EBD studies have addressed the stress-reduction effects of daylight, art with realistic nature content, and many other design factors, among adult patients in healthcare settings. There is, however, limited research on pediatric subjects concerning these impacts. This is surprising considering the important role early childhood development plays on a person's lifelong development. On the other hand, children's well-being and developmental issues have been studied within a wide range of environmental settings such as classrooms (Palitz, 2003) and residential environments (Huffcut, 2010). In healthcare settings, pediatric patients may experience more difficulties than adults, as argued by Kozlovsky (2013, p. 141). But research gaps remain for the relationship between physical environmental factors and pediatric healing outcomes.

1.3 INTRODUCTION OF THE STUDY

To address this gap of knowledge, this study aimed to examine how daylight affects children's behaviors in pediatric waiting areas. After reviewing literature and developing a relevant conceptual model, the researcher hypothesized that 1) the presence of higher levels of daylight would result in an decreased number of undesirable negative behaviors among children in the waiting rooms, and 2) the presence of higher levels of daylight would result in an increased number of positive behaviors among children in the same settings.

Ten pediatric hospitals and clinics in the Bryan/College Station area in Texas were contacted either by phone or in person to ask for permissions for site visits. Five sites gave the researcher permissions for site visits. The researcher paid an hour-long visit to each of the five sites and found out that these sites were rather diverse in terms of window sizes and levels of daylight. However, only two sites provided final approvals for the researcher's proposed research activity. The first site is a general clinic. The second site is dental clinic.

This study is a correlational study for the relationship between light levels in pediatric clinic waiting areas and children's behavior. After receiving the approvals from the two sites and the Institutional Review Board (IRB) at Texas A&M University, the research carried out a Pilot Study to test the research protocol and to get familiar to the tools. A pilot study was conducted to understand the site conditions through field visits. The first site has two waiting rooms, but one of them was excluded due to lack of patients. The remaining one (Room A) has large scaled windows. The second site included one waiting room (Room B) with larger windows.

For the Main Study, the observations were made over a five-week period in early spring of 2014 for five days each week throughout the open hours, which was from 8:00 AM to 5:00 PM in the first site (Room A) and 9:00 AM to 5:00 PM in the second site (Room B). During each observation day, the actual observation was conducted in 30-mintue sessions, with ten minute rest periods in between sessions. A total of 223 observation sessions (147 in Room A, 86 in Room B) were conducted. Data collection was stopped in Room B because saturation was reached with repeated behavioral patterns. Total of 113 hours observation of total of over one thousands of children were conducted through the observational study.

Both quantitative and qualitative methods were used in this study. Light levels, peak noise values, and the room temperature were measured at the beginning of each observation session. Children's behaviors were observed continuously in each thirty-minute session. Qualitative methods were used to collect and analyze descriptive data. For example, the interior environmental features of the waiting rooms were illustrated with texts, photos, and floor plans; descriptive notes were taken for the unanticipated incidents of children's behaviors or unexpected occurrences of noise.

The observed behaviors were separated into two categories: positive behaviors and negative behaviors, and analyzed using quantitative approaches. The positive behaviors included laughing, running happily, singing, and speaking to oneself and making cute and funny sounds. The negative behaviors included crying, shouting, hitting, getting restless in seats, getting impatient and getting out of their seats, and getting impatient and starting to talk to parents. Singing and crying were recorded by the duration of the occurrences in seconds. The rest of the behaviors were recorded by the number of the occurrences.

Further details of the literature review, the methodology of the present study, the process of the data analysis and the results, the discussions, and conclusions are explained in the subsequent chapters.

CHAPTER II

LITERATURE REVIEW

2.1 GOAL AND METHODOLOGY FOR LITERATURE REVIEW

To better understand the impact of the built environment on children, the researcher conducted a broad literature review about stress-reducing design strategies for children in diverse settings, including workplaces, schools, and healthcare settings. Environmental qualities found to reduce stress were researched in more detail, as well as environmental issues in children's development.

This literature review was conducted before and during the process of data collection. Part of the literature was added after the data collection since the observations on site raised new questions associated with the researcher questions. Keywords related to healing environment, evidence-based design, daylight, nature, window view, positive distraction, music, scent, seating option, noise, stress, children's well-being, children's development, children's color preference, children's behaviors, children's physical activities, children's fear, children's trauma, life-span development, sleep pattern, and the relationship between environmental design on physical activities were used. References included books from the Evans Library at Texas A&M University and the Technical Reference Center (TRC) in the College of Architecture, Texas A&M University; journal articles obtained through the Texas A&M University library website and "Web Search" functions in EndNote X5 and EndNote X6. Other books and journal articles were borrowed from outside Texas A&M University through the "Get it for me" service at Texas A&M University.

2.2 LITERATURE REVIEW ON DAYLIGHT

To fully understand the current knowledge regarding the impact of daylight, literature was reviewed on theories regarding access to nature and daylight, and the influence of daylight on office workers in general working spaces; staff, students, and faculty in educational areas; and staff, patients, adult students, and pediatric patients in healthcare settings.

Joseph (2006) summarized four different ways daylight impacts humans, including supporting visual performance and tasks, managing the body's circadian system, influencing perception and mood, and facilitating direct absorption of elements such as vitamin D for chemical reactions within the body. (See Figure 2.1).

1) Daylight enables visual performance and tasks.
2) Daylight controls the body's circadian system.
3) Daylight facilitates direct absorption for critical chemical reactions within the body.
4) Daylight also affects mood and perception.

Figure 2.1 Four ways daylight affects humans (Joseph, 2006)

2.2.1 Daylight Supports Visual Performance and Tasks

For adults in office settings, daylight is linked to better office satisfaction and thus higher productivity (Mayhoub & Carter, 2011). Leather and colleagues (1998) conducted a survey and found that direct sunlight increased worker satisfaction. In this study, daylight was measured with a Eurisem Technics Digital Lux meter (model EP628) at the center of the working area and the four corners. Window view was measured by the percentage of observable greenery. They also found that views of natural elements reduced worker stress.

Kim (1997) studied the impact of daylight on college students in classrooms with different levels of daylight and window views. One hundred and sixty participants were assigned to experiment groups. The daylight level was controlled by a changeable window wall, and slides of different window views were shown on a translucent screen to mimic real window views. Light level was measured while evaluating enhanced academic attributes of students such as the ability to concentrate, student interest in class content, and level of attendance. In the first experiment, student academic satisfaction was investigated in classrooms with or without windows. The results show that while there was no difference between the classrooms with windows that do not provide daylight or window views and the rooms with no windows; the rooms with windows that provide daylight and a good view were the most effective in increasing academic satisfaction. In the second experiment, the window preference of participants was tested. The results also show that the windows that provide daylight and a good view were more preferred and were the most effective in increasing academic satisfaction.

Kilic and Hasirci conducted a study investigating users' perceptions of daylight in the Main Library of Dundee University in Scotland. The library is a socializing and studying hub for staff and students. It is designed with windows with limited daylight and views. After showing the subjects a model of the library, the 81 participants, including 20 library staff, students, and faculty, were given a questionnaire asking their preference for seats according to the amount of daylight and views. Fifty-six percent of the participants preferred to sit near the window because of the daylight and the view through the windows (2011).

In healthcare settings, task-supportive lighting was recommended for staff that relies on an adequate amount of light to carry out daily tasks and in order to maintain low stress levels (Shepley, 2002, 2004). Daylight in healthcare stings may also have a positive impact on staff efficiency and communication, thus reducing medical errors. In a study conducted in Turkey, the relationship between at least three hours of sunlight exposure and positive effects on staff fatigue was suggested (Alimoglu & Donmez, 2005). Similar results were found in Zadeh and colleagues' study (2014) on window and daylight's impact on nurses' well-being comparing wards with daylight and those without daylight. Twelve registered nurses (NR) participated in the study. Behavior mapping and physiological measurements were used to detect the impact of daylight on the subjects' behavioral and physiological outcomes. Blood pressures, heart rates, temperature, and oxygen saturation were recorded. Data on medical errors though three years in the two types of wards were compared. Significantly higher means of the nurses' laughter were found in the wards with windows compared to the wards without windows.

2.2.2 Daylight Affects Physiological Cycle

Joseph (2006) suggests that daylight controls the body's circadian system and that disturbances to the circadian system may result in physical diseases and emotional disorders.

Several studies have found that daylight helped improve senior Alzheimer patients' circadian cycles and sleep patterns. White, Ancoli-Israel, & Wilson (2013) conducted a meta-analysis of existing randomized control trial studies with a focus on the impact of lighting design on senior patients in nursing homes. They found that natural light is suggested to have a positive effect on senior patients with diseases such as Alzheimer's (Ancoli-Israel, Martin, Kripke, Marler, & Klauber,2002; Ancoli-Israel, et. al., 2003), while too bright and unexpected light during the day may end up disturb patient rest and sleep in the night (Bliwise, Carroll, Lee, Nekich, & Dement, 1993; Shochat et al., 2000). These researchers argue that bright light higher than 1000 or 2000 lux affects the amplitude of the circadian rhythm cycle. Lack of daylight during the day and exposure to bright light during the night both affect senior patient sleep patterns. Ancoli-Israel, Martin, Kripke, Marler & Klauber (2002) studied the exposure to daylight in the morning among seventy-seven residents of two nursing homes in the San Diego area for ten days. The participants were assigned to groups with different lighting interventions during different times of the day. The sleep patterns and the peak and the mean of rhythm activities were recorded. No significant differences in sleep were found.

However, the results did show that the peak of the rhythm is delayed and the circadian rhythm cycle is more robust with the light intervention. Ancoli-Israel et al., (2003) conducted a follow-up study on the impact of lighting on the sleep patterns of seventy-two Alzheimer nursing home patients. An Act illume recorder that measures both wrist activities and light exposure was used. Sleep patterns and circadian activities were analyzed. No significant difference in sleep time was detected but significant differences were found in durations of wake times due to the light exposure. The researchers argued that lighting itself might not be enough to help improve sleep patterns. Other factors such as increased physical activity may be important to sleep improvement.

2.2.3 Daylight's Benefits on Body Chemicals and Nutrients

Walch et al. (2005) concluded that sunlight decreased patient pain after surgery. Light was measured twice a day at the center of a patient's room window. The McGill pain questionnaire and Center for Epidemiological Studies Depression Scale were used to measure pain levels and depression levels. At discharge, the patients on the brighter side of their room showed a significant decrease in perceived stress and in pain. The chemical impact of sunlight may account for these changes; sunlight is known for helping human skin absorb Vitamin D (Boubekri, 2008).

2.2.4 Natural Light Has a Mood-elevating Effect

Last but not least, daylight also affects mood and perception. Dellinger (2009, p. 56) introduced Malone's principle, which suggests that natural light has a mood-elevating effect. Küller and colleagues conducted a study on the impact of indoor lighting and color on 998 office workers. The results showed that the participants' mood was the lowest when the room was darker, was the highest when the room was bright with the suitable light levels, and declined when the room started getting too bright (Küller, Ballal, Laike, Mikellides, & Tonello, 2006).

2.3 IMPACT OF DAYLIGHT ON CHILDREN

Piaget portrays childhood as a period of seeking out and exploring the natural world (Verbeek & de Waal, 2002), and daylight might be critical to this process. To explore the current understanding of the impact of daylight on children, literature on this subject was searched. Limited studies were found. However, the existing studies suggest that daylight has a positive impact on children in both general settings and healthcare environments.

Studies in schools suggested that school children perform better and progress faster in settings with more daylight. Palitz (2003) investigated the stress-reducing effect of daylight on 90 school children during a school year. Room temperature as a variable was measured. The children were assigned to four classrooms with different sized windows and various natural light levels. Their behaviors were observed and compared. Each child was observed 20 times over a 30-minute period. ANOVA tests suggested that children had higher stress hormone levels and lower annual body growth in the rooms without windows and with reduced daylight. Although these studies were not conducted in healthcare settings, the positive effect of natural daylight on children is suggested.

One study on the impact of daylight on children involved interviews of adolescent patients ages 12 to 18. In this study, the research team interviewed adolescents with behavioral or emotional disorders and their perspectives on the interior design factors of the residence facility. The results show that increased daylight was preferred by the interviewees (Huffcut, 2010).

In conclusion, previous studies suggested that daylight supports positive mood and increased academic satisfaction. However, literature of the impact of daylight on children in healthcare settings is limited.

2.4 IMPACTS OF OTHER ENVIRONMENTAL FACTORS

2.4.1 Nature View

Nature views are a major component of access to nature, and have often been studied together with the impact of natural light. Therefore, a literature review was conducted on nature views. The results suggested that nature views can reduce patient stress, shorten length of stay, reduce staff stress and fatigue, and promote staff's satisfaction of work environments.

According to Wilson's Biophilia hypothesis, humans have an instinctive bond to living systems and the urge to affiliate with other forms of life (Wilson, 2007). Humans experience satisfaction from having contact with nature and appreciate the natural beauty of nature (Kellert, 1993). Positive impacts of daylight and nature views on humans' physical, mental, and spiritual health have been suggested by previous studies.

In Ulrich's landmark study comparing healing outcomes between rooms with and without nature views (1984), patients were admitted after surgery in a suburban hospital into rooms with either a window view of a brick wall or a window view of nature. The medical reports of these patients between the years of 1972 to 1981 were then examined and compared. The results show that the average number of days patients stayed in rooms with nature views was 0.74 days less than the patients in rooms with the view of the brick wall. Further, patients who stayed in the rooms with nature views required less strong pain killer medications and made fewer negative comments to their caregivers. Since this study, the healing effects of nature have drawn increased attention among healthcare design practitioners and researchers.

Ulrich et al. (2006) reviewed nearly 700 hundred studies on the impacts of the built environment on patient outcomes. The result suggests that positive distractions in healing environments reduce patient stress, together with other factors such as daylight, which is suggested to reduce depression and pain.

Pati, Harvey, and Barach (2008) conducted a survey study on the stress and fatigue levels of thirty-two staff in two healthcare facilities, which provided either nature view or no nature view. The researchers found that the staff with views of nature experienced lower stress levels than staff who were provided with no view or non-nature views.

Shepley, Rybkowski, Aliber, and Lange (2012) conducted a pre- and post-occupancy study on staff and patients' perceptions in the infusion area of a cancer center, which moved to a new facility with more access to nature. The results show that the staff and the patients experienced more access to nature in the new facility and 93% of the 17 respondents in the old facility and 91% of the 22 respondents in the new facility agreed that the access to nature is important.

Regarding the impact of art in these spaces, although many previous studies have been focusing on the impact of a nature view, the results of which show that viewing nature has stress-reducing effects on adults, there is limited research conducted focusing on children even though adults and children have strong cognitive differences. The few studies include one study about children's preference for nature art (Eisen, 2006; Eisen, Ulrich, Shepley, Varni, & Sherman, 2008) and a study on children's preference for color art and fear and impact of art on pediatric patients (Bishop, 2012).

Eisen and colleagues conducted a three-phase study and compared healthy school children and hospitalized children for their preferences of nature scenes. During the first phase of the study, school children aged five to seven were shown six slides of nature images and were asked which image they preferred. The results showed that children prefer nature pictures rather than urban scenes. During the second phase of the study, hospitalized children were shown the pictures and asked how they liked them. During the third phase of the study, hospitalized children were exposed to nature images and abstract images and were assessed for outcomes such as blood pressure, respiration and heart rate. The results suggested that children ages 5 to 17 prefer nature art for a less stressful healing environment, but the blood pressure and the respiration data did not show significant differences between nature images and abstract images.

Urban children's nature perspectives have been studied. Children prefer outdoor nature images that remind them of outdoor activities and relaxing environments, but fear those nature environments that might cause bodily injury (Simmons, 1994). The results agree with the predictions of children's behaviors towards natural hazardous Heerwagen and Orians argued (2002).

In another study, over 400 children were asked which landscape images they preferred. The results showed that 11-year-olds prefer non-shadowed and less illustrated pictures than do 17-year-olds (Bernaldez, Gallardo, & Abelló, 1987).

2.4.2 Positive Distractors

Positive distractors were suggested to have the effect of promoting healing outcomes and are receiving global attention (Campagnol & Shepley, 2014). Shepley (2006) conducted a literature review on positive distractions such as daylight, nature, and music. Music was suggested to have positive impact on stress-reduction (Mazer, 2010; Rubin, Owens, & Golden, 1998). Besides the daylight, nature view, and music, it was also suggested in the study that less saturated colors are preferred by individuals with higher stress levels and more representative pictures were also thought to be preferable for patients than abstract pictures.

In a later study, Shepley, Harris, & White (2008) compared critical care units with only single family rooms to units combined with open-bay units. They argued that a single family room provides patients with more privacy and promotes interaction between mothers and their infants through experiences such as breast-feeding. They conducted a survey study on 75 staff in two healthcare facilities. The result of the study also suggested that the single family room increased staff satisfaction and reduced their stress. The study was also discussed in an earlier paper written by Harris, Shepley, White, Kolberg, and Harrell (2006).

As far as using art, appropriate art styles for different areas in healthcare facilities have been studied in Hathorn and Nanda's study (2008). Natural images are suggested for most of the healing areas while abstract art is thought to be inappropriate. The restorative effect of nature pictures was also demonstrated in the study of Ulrich et al. (1991).

2.5 CHILDREN'S PSYCHOLOGICAL WELL-BEING

2.5.1 Children's Fear and Stress

Due to the difference in children's environmental needs and development, literature was searched to study this subject. The results suggested that children's needs vary over their lifespans. For example, the need for touch and attention, the fear of separation from parents, and the fear of strangers start at different ages. Unlike the stress that adults may suffer from daily life events, children's fears focus on real threats and are usually age-specific (King, Hamilton, & Ollendick, 1988). From the age of 6-months, children begin to fear strangers, separation from parents, and bodily injury (Morris & Kratochwill, 1983). Sensitivity and patience are needed to help them to deal with these fears (Black & Puckett, 1996).

Children's fears can be quite real to them and may lead to lifelong harm and trauma. Both academic and practice groups aim to improve vulnerable children's well-being (Pecora & Harrison-Jackson, 2010) and thus make a change in a child's life by helping them to handle physical and psychological issues (Rosenberg, 1995).

Children undergo severe fear and stress during hospitalization (Dall, 1975). U.S. children's hospitals have been trying different design methods to improve the built healing environment. Cassidy and colleagues compared children's perceived pain during immunization and found higher level of distraction was related to lower level of pain

(2002). Bellieni and colleagues (2006) conducted a similar study of the analgesic effect of watching TV during venipuncture among 69 children and found that children who watched cartoon reported lower level of pain during venipuncture.

Children admitted into intensive care units (ICU) undergo severe stress, which may affect both their physical and mental health (Bood, 1996). Young children are also at risk for post-hospital adjustment problems (Small & Melnyk, 2006), and fear and anxiety experienced in ICU's may become negative memories afterwards (Frederickson, 1979). The stress may also deteriorate their behavior and their social interactions. According to Piaget's theory on children's development in early childhood, these negative memories may last throughout their lives. Therefore, it is important to alleviate stress among hospitalized pediatric patients in ICU's to promote their healing outcomes.

2.5.2 Children's Psychological Well-being in Pediatric Settings

Pediatric settings have been a focus of research due to the importance of children's well-being and satisfaction in healthcare settings. Interventions such as playing, painting, and reading have been suggested to have the effect of reducing children's agitated behaviors. Other factors such as parents' company, play and toys, and televation had positive distracting effects.

One study tested the distractive effects of parents' accompany when pediatric patients received venipuncture. Researchers found that parental presence decreased the child's fear (Cavender, Goff, Hollon, & Guzzetta, 2004). In another similar study, an investigation using the Children's Fear Scale was conducted on young school children. Children and their parents were filmed while the children received venipuncture. The scale was used for children and their parents to rate the pain level. Results showed that the scale is concurrent with children's self-reports (McMurtry, Noel, Chambers, & McGrath, 2011).

Besides TV distraction and parental support, music therapies (McDonnell, 1983; Preti & Welch, 2011), play therapy (Andersson, 1979), toys (Vessey, Carlson, & McGill, 1994) and other methods were used in hospitals to alleviate children's fear and stress. Alcock et al (1985) had 625 children and their family members assigned to control groups and experimental groups in a children's hospital and a general hospital. Behaviors of the children and their family members were recorded and later analyzed. The results show that compared to the children in the control group, the children with the interventions such as playing activities and children life workers had more positive behaviors such as interacting more calmly with their parents. When compared to the children in the control group, the children with the life intervention showed fewer negative behaviors such as screaming. The findings showed that children who were playing, painting, or reading showed fewer passive or aggressive behaviors. As a result, the parents also showed less agitated behavior.

In Alcock et. al's study (1985), children's behaviors were recorded in waiting rooms with or without the life intervention as mentioned above. The researchers found that pediatric patients from two hospitals show more passive behaviors in the waiting rooms without the life intervention.

In another study in the Charing Cross Hospital, playrooms were provided for family members and children patients in the waiting roms and in the children's wards.

Paint, paper, and toys were provided in these waiting rooms. No effectiveness was measured (Leffman & Murton, 1977).

Another study examined children’s supervised play in the waiting room in an outpatient neurology clinic (Ispa, Barrette, & Kim, 1988). Thirty children, aged five to ten and adults were observed. The results show that while supervised playing was provided, the children demonstrated fewer irritable behaviors.

A method of using teddy bears as pretend patients was used in a children’s hospital in Dallas. Hospitalized children were asked to conduct medical operations on teddy bears as doctors in order to reduce their fear of unknown procedures. The result shows that children experienced lower levels of anxiety afterwards (Bloch & Toker, 2008).

Children’s development and well-being has been of interest to many architects (Baird & Lutkus, 1982), and the number of studies focusing on hospitalized children’s physical and mental well-being is rising. However, little research has been conducted on the built pediatric environments.

2.6 RESEARCH GAP

A large number of studies have been conducted in healthcare settings to examine stress-reduction effect of built environments (Ulrich, 2008). However, due to the wide range and the variety of research topics, a universal database cannot be drawn (Stankos & Schwarz, 2007). Previous studies suggested that daylight, nature view, and many other positive environmental factors promote healing outcomes of adult patients and reduce their pain and stress. However, evidence of the impact of daylight on pediatric patients is very limited. Healthcare environments for pediatric patients need to be studied since the perception, the preference, and the cognition behaviors of children differ significantly from those of adults and the effects of healthcare environments on children's patient behaviors can have significant impacts on their healing outcomes.

CHAPTER III

STYUDY DESIGN AND METHODOLOGY

3.1 OBJECTIVE AND HYPOTHESES

This study examines how daylight affects children's behaviors in pediatric waiting areas. It is a correlational study on the relationship between light levels in pediatric clinic waiting areas and children's behavior. After reviewing literature and developing a relevant conceptual model, the researcher hypothesized that 1) the presence of higher levels of daylight would result in a decreased number of undesirable negative behaviors among children in the waiting rooms, and 2) the presence of higher levels of daylight would result in an increased number of positive behaviors among children in the same settings.

3.2 CONCEPTUAL MODEL

The hypotheses were based on the literature review and the conceptual model. The conceptual model consisted of independent variables, dependent variables, and confounding variables.

3.2.1 Independent Variables

The primary independent variable in the study was light level. Noise and temperature were also recorded for future study use.

3.2.2 Dependent Variables

The dependent variables of this study consisted of the occurrence and frequency of children's behaviors, such as sitting restlessly, crying, laughing, and running around happily. The behaviors were divided into two groups: negative behaviors and positive behaviors. Negative behaviors included aggressive behaviors such as hitting. Positive behaviors included laugh, sing, run around happily, and speak to oneself and make cute sounds. The occurrences of the behaviors were counted.

A similar method was used in Nanda, Eisen, Zadeh, and Owen's study (2011) in which patients' behaviors in Emergency waiting rooms were observed. The behaviors were divided into continuous behaviors and discrete behaviors, including using cell phones, watching television, looking out the window, talking, and dozing. In this study, ANOVA tests were conducted to analyze the data. With the P-value smaller than 0.01, patients' restless and anxious behaviors showed differences before and after the use of the nature pictures. Fewer restless and anxious behaviors were noted when nature pictures were present in the room.

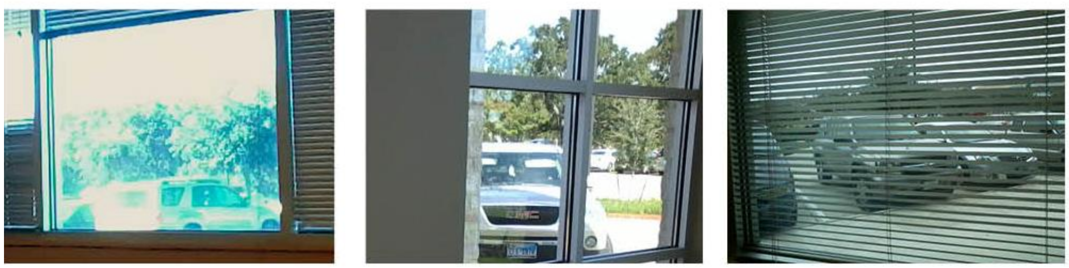
3.2.3 Confounding Variables

Window view, nature pictures, noise, room temperature, and interior decoration, also affect the patients and the staff (Quan, Joseph, Malone, & Pati, 2011; Ulrich, 1984). The extraneous variables of the present study included window view, the volume of the television, room temperature, the color of the wall and carpet, and seating options.

3.2.3.1 Window views and images of nature

The waiting rooms used in the present study had similar window views. The contents of the views consisted of the parking lot, bushes and grass. Besides the natural view from the windows, Room C had a nature picture hanging on the wall while Room A and Room B both had indoor plants. (See Figure 3.1and Figure 3.2).

As the present observational study takes place in the real world, that is, in the waiting rooms of different clinics in College Station, TX, the variations among the rooms constitute the confounding variables in this study and, therefore, puts the reliability and validity of the study results at risk. These differences include the administration system of each clinic, the subjects' social background and health conditions, and the different physical environment.



A B C

Figure 3.1 Window views in the waiting rooms

A B C

Figure 3.2 Nature image and indoor plants in the waiting rooms

3.2.3.2 Noise

Noise is thought to affect patients' healing process and their sleep patterns (Quan, Joseph, Malone, & Pati, 2011). It may also have an impact on patient stress in waiting areas (Nanda et al., 2012). Noise in the present study was created by the patients, the family members, the staff, and from the opening and closing of the doors. Televisions at both sites were turned off during the observations.

3.2.3.3 Interior space

The interior decoration in the present study refers to the carpet and wall paint color, sound-proof wall finishing and acoustical ceiling tiles, all of which might affect outcomes in built healthcare environments. Ulrich, Berry, Quan, and Turner (2010) also generated a similar framework of environmental study design.

The graphic conceptual framework is shown in Figure 3.3.

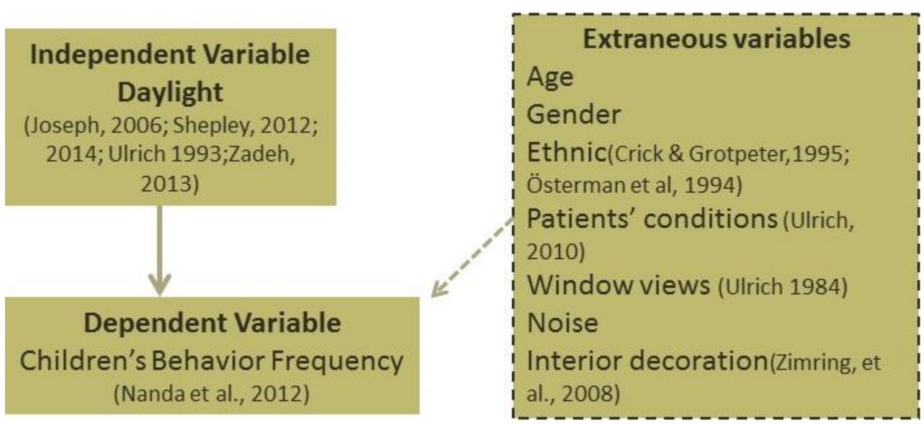


Figure 3.3 Conceptual framework of the present study

3.3 SITE SELECTION

Local pediatric clinics were selected to be included in the study for practical reasons. Ten pediatric hospitals and clinics in the Bryan/College Station area in Texas were contacted either by phone or in person to ask for permissions for site visits. Five sites gave the researcher permissions for site visits. The researcher paid an hour-long visit to each of the five sites and found out that these sites were rather diverse in terms of window sizes and levels of daylight. Two sites provided final approvals for the researcher's proposed research activity.

The clinics were only informed about the general topic and methodology of the study, in order not to affect the participants' behaviors and to encourage a more natural result.

The researcher conducted an hour-long casual observation in each waiting room at both clinics during site selection. Patient behaviors were noted for the purpose of developing a behavior coding system. The sample size was estimated. The first clinic confirmed that they typically serve 60 patients a day in the combined waiting rooms. The dentistry confirmed that they typically see 35-55 patients a day. This data suggested approximately 1,000 patients during the 150 hours of observation. Accounting for the time needed to gather information regarding room temperature, etc., it was likely that no less than a thousand children would be observed over the course of the study.

The researcher also visited a local children's hospital and, after finding out that the hospital didn't have windows in the waiting area, asked for permission to conduct the study there in order to compare the outcomes with the two clinics used in this study both of which have windows. Unfortunately, the hospital informed the researcher that they didn't allow research to be conducted on site. Of the ten clinics approached, only two agreed to participate, one was a general practice clinic and the other was a dentistry clinic. The researcher was dressed casually and made an effort to blend in with other patients and their family members in order not to disturb them. No identification or photos were taken of the patients or their family members.

During the site visits, the researcher observed the design of the waiting rooms in these clinics and the behaviors of the patients. The researcher calibrated and estimated the size of and views from the windows to confirm the similarity of each of the study sites. Size, content, and percentage of greenery of nature images in all the waiting rooms were recorded. The researcher learned that the designs of the local pediatric waiting rooms vary broadly. Most of the clinics were one-story individual offices with relatively spacious waiting rooms and windows that allow daylight into the room. Some clinics had either multiple large or average sized windows which allowed in plenty of natural light. Still other clinics had windows with colored glass due to the interior design of the space which resulted in dimmer lighting. Still other clinics had windows with blinds which reduced the amount sunlight and glare. There were also clinics that were within a hospital building with no windows at all.

After the site visits, the waiting rooms were analyzed and compared to each other. The study methods and hypotheses were decided. The sites were contacted again. Permission to conduct the observational study was received from two clinics.

The two sites both have large windows. Room A in the first sites had windows which were approximately 9 feet by 21 feet and cover 75% of the window wall. The windows at Room B in the second site were approximately 24 by 36 and cover 86% of the window wall. This difference in light levels is a result of the distinct orientations of the buildings and the impact of shading due to the canopy overhanging the windows in Site A. The window wall of Room A faces the north while the window wall of Room B faces the east. Room B has a tall glass window facing directly outside. There was another waiting room in the first site that was included in the Pilot Study but was eliminated for the Main Study due to the lack of patients who used the room. The room was called Room C. The windows in Room C were approximately 9 feet by 15 feet and cover 62% of the window wall. For window examples of sizes, shapes, and styles, see Figure 3.4.

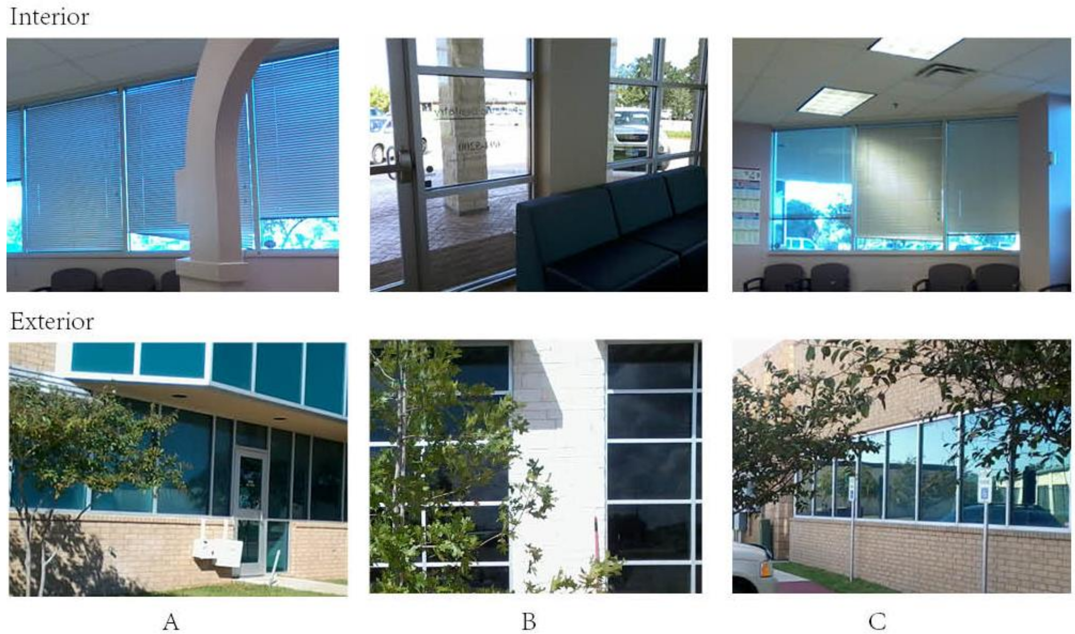


Figure 3.4 Window shapes and sizes

3.4 STUDY DESIGN

Observation is an efficient method in studies with children subjects (Singer & Singer, 1969). Therefore the researcher designed an observational study in order to collect data of children's behaviors in pediatric waiting areas. This method was used on children's behaviors (Alcock et. al, 1985; McMurtry, Noel, Chambers, & McGrath, 2011) and on the usage of hospital waiting areas in emergency department (Nanda et al., 2012). On-site observation was used to gather data on children's behaviors during the Pilot Study and the final study.

The researcher conducted a pilot study in order to get familiar with the tools and to reduce possible operating errors during the main procedure. Many researchers use pilot studies. A pilot study can save researcher's time by testing a method to see whether the method will or will not effectively answer the research question. Researchers often use pilot studies to test their procedures and reliability (e.g., Eisen, 2006, 2008); Rodiek and colleagues (Rodiek, Nejati, Bardenhagen, Lee, & Senes, 2014) used a small-scale pilot study of their outdoor survey before conducting the main study. The information from the pilot study helped develop the instruments for the main study. The Pilot Study and the main observation were done over the winter of 2013 and the spring of 2014.

Pilot studies have been used in former studies to advise the final tool (Eisen, 2006, 2008; Nanda et al., 2012). A three-day pilot observational study was conducted in two clinics, one of which had two children's waiting rooms, (referred as Room A and Room C) and the other of which had one, (referred as Room B). The behavior counts of the Pilot Study were for the purpose of getting familiar with the tool. The numbers was not documented or analyzed statistically.

This mixed-method study was designed to examine the relationship between the physical environment of children and their behavior patterns. Qualitative methods such as seating mapping and observation diary were designed to describe the interior space and children's behaviors. Quantitative methods such as behavior counting and statistical analysis were used to enumerate children's behavior frequency and seating usage.

3.5 RESEARCH PROCEDURE

After receiving the approvals from the two sites and the Institutional Review Board (IRB) at Texas A&M University, the research carried out a Pilot Study to test the research protocol and to get familiar to the tools. A pilot study was conducted to understand the site conditions through field visits. The first site has two waiting rooms, but one of them was excluded after the pilot study due to the low numbers of the users. The remaining one (Room A) has large scaled windows and natural light coming in through the windows. The second site included one waiting room (Room B) with large scaled window wall and natural light coming in through the window wall.

For the Main Study, the observations were made over a five-week period in early spring of 2014 for five days each week from 8:00 AM to 5:00 PM in the first site (Room A) and 9:00 AM to 5:00 PM in the second site (Room B). During each observation day, the actual observation was conducted in 30-mintue sessions, with ten minute rest periods in between sessions. A total of 223 observation sessions (147 in Room A, 86 in Room B) were conducted. The researcher stopped the observation when repeated behavioral pattern occurred in the second site. A total of over one thousands of children were observed through the observational study.

Both quantitative and qualitative methods were used in this study. Light levels, peak noise values, and the room temperature were measured at the beginning of each observation session. Children's behaviors were observed continuously in each thirty-minute session. Qualitative methods were used to collect and analyze descriptive data. For example, the interior environmental features of the waiting rooms were illustrated with texts, photos, and floor plans; descriptive notes were taken for the unanticipated incidents of children's behaviors or unexpected occurrences of noise.

The observed behaviors were separated into two categories: positive behaviors and negative behaviors, and analyzed using quantitative approaches. The positive behaviors included laughing, running happily, singing, and speaking to oneself and making cute and funny sounds. The negative behaviors included crying, shouting, hitting, getting restless in seats, getting impatient and getting out of their seats, and getting impatient and starting to talk to parents. Singing and crying were recorded by the duration of the occurrences in seconds. The rest of the behaviors were recorded by the number of the occurrences.

Further details of the literature review, the methodology of the present study, the process of the data analysis and the results, the discussions, and conclusions are explained in the subsequent chapters.

3.5.1 Measuring Light Levels

On the days of the observation, light levels were measured horizontally at the children's eye level in the waiting rooms at different locations such as at the window, where the light comes in, in the middle of the room, and the farthest point in the room from the window. As opposed to artificial light which is constant, the amount of natural light coming from the outside varies with the time of the day. The light levels were also measured multiple times.

Although the light level was primarily measured prior to each observation session at one fixed spot in the waiting room, there were also a few instances when the light was measured at other times of the day and in multiple locations in the room in order to create data for comparison in future studies.

A similar method was used in a study of Shepley and colleagues (2012), in which light levels were measured in ICU rooms on the north, south, east, and west side. In each room, light levels were measured from where the light entered the room and at head of the bed. In a study conducted by Walch et al. (2005), light was measured twice a day at the center of the window. In the study daylight was measured with a Eurisem Technics Digital Lux meter (model EP628) at the center of the working area and the four corners of the room. Window view was measured by the percentage of the greenery. In Zadeh and colleagues' study (2014), due to the orientation of nurses' working surface, light was measured horizontally every 5 minutes and then calculated into average readings per hour.

EXTECH Light Meter 401025 was used to measure the noise levels. This meter has Lux and Fc display mode in 3 ranges. The device was checked out at the help desk of Texas A&M University, department of Architecture. One Lux roughly equals ten times of Fc readings. The device can be set into fast (1 second) mode or slow (2 second) response mode. The meter can be checked out from the Department of Architecture, TAMU. The features of this equipment suit the research protocol. EXTECH light meter was also used in Zadeh's study to measure light levels (2014).

The interval needed to be decided based on the planned time to measure the independent variables such as the daylight level and the noise, and to reduce researcher errors caused by fatigue. Light levels were measured at the beginning of each 30-minute observation session.

Light levels were measured at the researcher's seats. The measurements were taken vertically at a sat down children's eye level.

3.5.2 Measuring Noise Levels

It was suggested in Nanda and colleagues' study on nature pictures in emergency waiting rooms (2012) that the noise level increases as people are stressed. Therefore the researcher also measured noise levels of the waiting rooms with a digital decibel meter. The model was DSLM-T193164. This sound meter was made to measure general noise levels as well as peak noise levels with the unit of decibel (dB).

Noise levels were measured at the beginning of each 30-minute observation session.

Noise levels were measured at the researcher's seats.

3.5.3 Measuring Room Temperature

Room temperature was also measured. The tool used was an ACU-RITE Temperature & Humidity Sensor. The measurement unit was Fahrenheit. The measurements were taken at the beginning of each 30-minute observation session. The measurements were taken at the researcher's seats.

3.5.4 Behavior Counts

The behaviors were chosen from a series of aggressive behaviors such as hitting, yelling, pushing and shoving, stressed/anxious behaviors such as crying, screaming, and sitting restlessly, and behaviors which showed that the patients were calm and less stressed such as reading, using a cell phone, playing with toys, reading a book, or calmly talking to their parents. Some of these categories of behavior were identified by the researcher. Others were compiled for the behavior list using a series of former studies. The behaviors used for the Pilot Study are listed in Table 3.1.

Table 3.1 Original behavior list

Impatient Behaviors	Crying
	Yelling (Chalmers, Olson, & Zurkowski, 1999)
	Hitting (Chalmers, Olson, & Zurkowski, 1999)
	Pacing (Nanda et al., 2012)
Calm Behaviors	Smile (Hendon & Bohon, 2008)
Interaction with Daylight	Move towards to the window (Kilic & Hasirci, 2011)

A similar method was used in a study by Cassidy et al. (2002), which measured children's pain level using children's facial actions such as brow lowering and eye squeezing. The control group had 33 children with TV with blank screen and the treatment group had 29 children watching an age-appropriate musical cartoon on the television. The study took place in two pediatric practices in Canada. Children's pain levels were measured by children's self-reports, facial actions, and the hospital pain scales. The mean time of the children looking at the TV screen was also measured.

After the Pilot Study observation, the behavior list was adjusted due to practical issues or the modified study design. For example, the researcher used Noldus observer XT 10.5 on the laptop instead of a pocket device that was planned before the Pilot Study was carried out. Therefore, behaviors that required the researcher to walk around the room were removed from the list. Results and new behavior list are included in Chapter III.

Occurrences of children's behaviors were counted and recorded using the Noldus observer XT 10.5. The software was previously installed to the laptop borrowed from the Center for Health Systems & Design, Texas A&M University. Behavior types can be programed and coded in the software. During the observation, the researcher can record the occurrence of each behavior by simply clicking a button of the code. Once the data is recorded, each behavior can be filtered and shown in one sheet with the total number of the occurrence, the mean, the rate per minute, the duration. Data can be exported to professional statistical software such as SPSS for further analysis. The software also provides basic statistics tests and numerical analysis, lag sequential analysis to reveal, and the reliability analysis.

Four types of data charts can be generated by the software, which includes columns, lines, pie charts, and scatter plots of the data. To create a chart, first, run the analysis of the variables you require, select the first column of data, press control key and select the second column of the data variable. After you create a chart, one can make changes or to add more columns of variables. You can also change the format to the chart details.

3.5.5 Observation Diary

An observation diary was kept to record unexpected events such as a new type of behavior or sudden noise level or light level change during the observation session.

Maps were made to detect the seating patterns of pediatric patients and their parents in the three waiting rooms, in the order of Room C, A, and B.

In Room C both children and parents seating options were recorded. In room A and at Room B, due to the large number of the patients and parents in the room, only children were counted. The researcher conducted four 30-minute observation sessions at Room C, fifteen 30-minute observation sessions at Room A, and eight 30-minute observation sessions at Room B.

In Room C, the researcher sat at seat 12 (the researcher's seats are marked with yellow stars in Figure 3.5). The researcher chose the seat because the location allowed the researcher to view the whole room clearly.

Figure 3.5 Room plans, showing researcher's seat

In Room A, the researcher first sat in seat 6 for two sessions. The seat was next to the windows. The reason the researcher chose this seat was because the seat is next to one of the only two tables in the room where the researcher could set the laptop on top.

The researcher then moved to seat 11 and used the same seat for the rest of the day and the next day (for a total of 12.5 hours at the site). The researcher chose this seat because it was the only seat next to a wall outlet for the laptop used in data collection.

In Room B, the researcher sat in seat 8.

For the Main Study the researcher used the new behavior list, measured the light levels, noise levels, and room temperature. While gathering data, the researcher sat at the same seats that had been used in the Pilot Study. Over two hundred 30-minute observation sessions were completed which included approximately fifteen hundred children in total.

3.6 HUMAN SUBJECTS

3.6.1 Population

The study used a convenience sample in two pediatric clinics in College Station, Texas. Based on the researcher's estimation during the observation, up to 80% of the patients in Room A were Hispanic, while the no obvious dominating population of Hispanic in Room B. Therefore, the majority of the patients were different between the sites. Regarding demographics, in Site A the majority of the patients were Hispanic while the ethnicity of the patients in Room B was more heterogeneous.

The demographic distribution in this city is shown in Table 3.2 and Table 3.3. Figure 3.6 demonstrates the relationship between Brazos County and the United States., and suggests similar distributions.

Table 3.2 2010 Demographic Profile of City of College Station (U.S. Census Bureau, 2015a)

Population estimate (total number)	93, 857
White alone, percent	77.2%
Black or African American alone, percent	6.8%
American Indian and Alaska Native alone, percent	0.4%
Asian alone, percent	9.1%
Native Hawaiian and Other Pacific Islander alone, percent	0.1%
Two or More Races, percent	1.6%
Hispanic or Latino, percent	14%
White alone, not Hispanic or Latino, percent	68.3%

Table 3.3 2013 demographic of USA (U.S. Census Bureau, 2015b)

Population estimate (total number)	316,128,839
White alone, percent	77.7%
Black or African American alone, percent	13.2%
American Indian and Alaska Native alone, percent	1.2%
Asian alone, percent	5.3%
Native Hawaiian and Other Pacific Islander alone, percent	0.2%
Two or More Races, percent	2.4%
Hispanic or Latino, percent	17.1%
White alone, not Hispanic or Latino, percent	62.6%

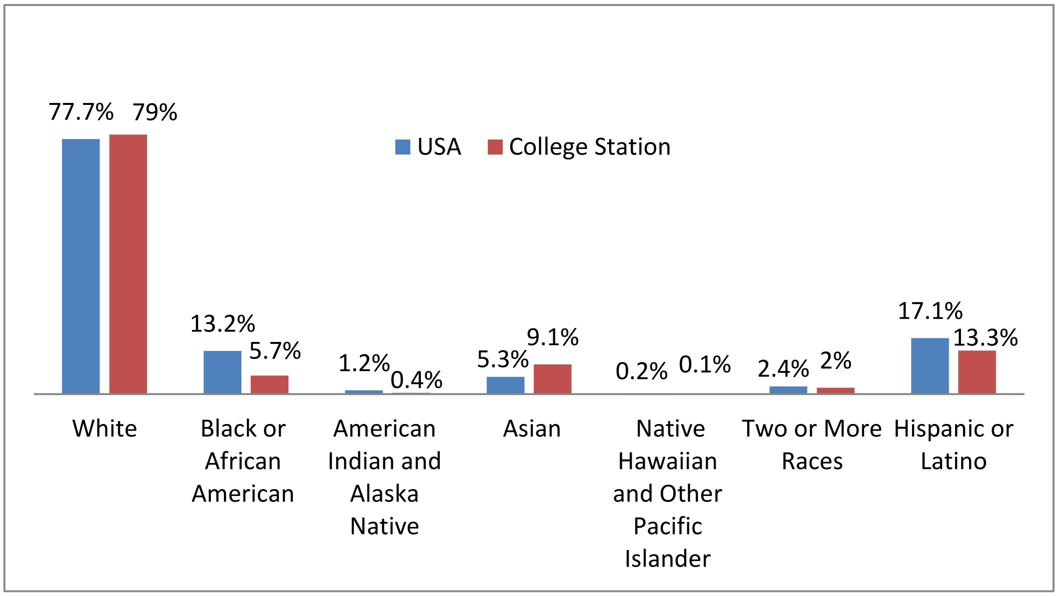


Figure 3.6 Comparison of the ethnic/racial distribution percentage of United States and Brazos County

3.6.2 Age Range

According to Piaget's theories, children's cognitive development has four different stages during which children perceive pictures differently (Siegler, DeLoache, & Eisenberg, 2006; Black & Puckett, 1996). At this level of the study, children of all ages (except infants who don't walk or talk yet) who come to the clinics were included. Age and gender data were noted but not analyzed.

3.6.3 Sample Size

Generally, the bigger the sample size is, the better the sample results represent the population. According to Gay and Airasian's guidelines, a sample of four hundred should be adequate for a population larger than five thousand (Leedy & Ormrod, 2014, p. 207). The present study included over one thousand children in pediatric waiting room settings.

CHAPTER IV

DATA ANALYSIS AND RESULTS

This chapter summarizes the data analysis and the results of both Pilot Study and Main Study. The behavior counts and the observation diary of the Pilot Study were for the purpose of getting the researcher familiar with the tools in order to reduce research errors. The results of Pilot Study were not analyzed inferentially, but instead guided the final tool design. The seating mapping of the Pilot Study was analyzed. The behavior counts and observation diary of the Main Study were analyzed after the Pilot Study results in this chapter.

4.1 PILOT STUDY

4.1.1 Seating Mapping

The seating option results were illustrated and in the floor plans (See Figures 4.1, 4.2, 4.3, 4.4 and 4.5). The frequency of the seats taken was described and summarized in words and tables.

In Room C, 60% of the children and parents chose (N=10) the seats close to the windows. The distribution was equally distributed throughout the space. (Refer to Figure 4.1, Table 4.1)

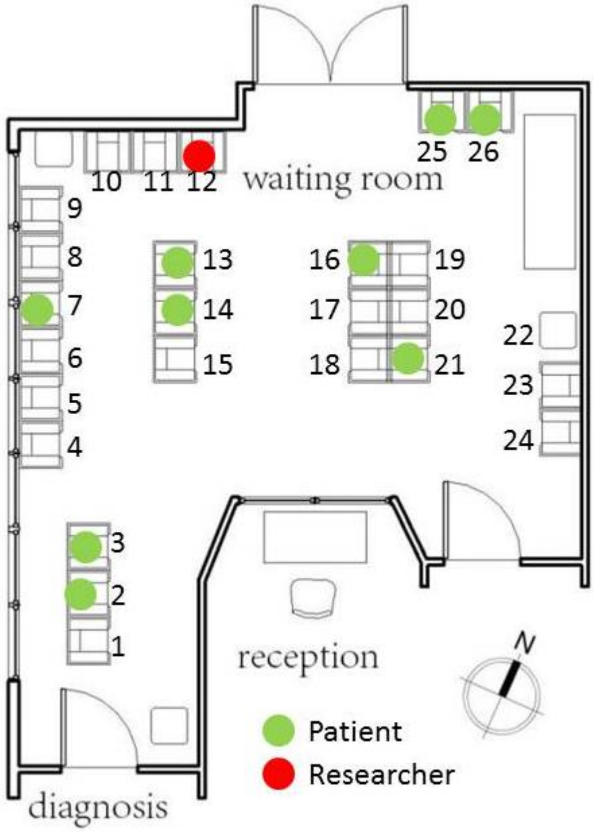


Figure 4.1 Seating choice in Room A, 10:40am-12:00pm, November 18, 2013

Table 4.1 Seating options in Room C

Seat Number	Number of Users	Percentage
1	0	0.00%
2	1	10.00%
3	2	20.00%
4	0	0.00%
5	0	0.00%
6	0	0.00%
7	1	10.00%
8	0	0.00%
9	0	0.00%
10	0	0.00%
11	0	0.00%
12	0	0.00%
13	1	10.00%
14	1	10.00%
15	0	0.00%
16	1	10.00%
17	0	0.00%
18	0	0.00%
19	0	0.00%
20	0	0.00%
21	1	10.00%
22	0	0.00%
23	0	0.00%
24	1	10.00%
25	1	10.00%

In Room A, within the two sessions the researcher was sitting in seat 6, six of the seven children chose the seats next to the windows. Three out of seven patients chose seat 1, which was located between the entrance and the windows. (See Figure 4.2, Table 4.2).

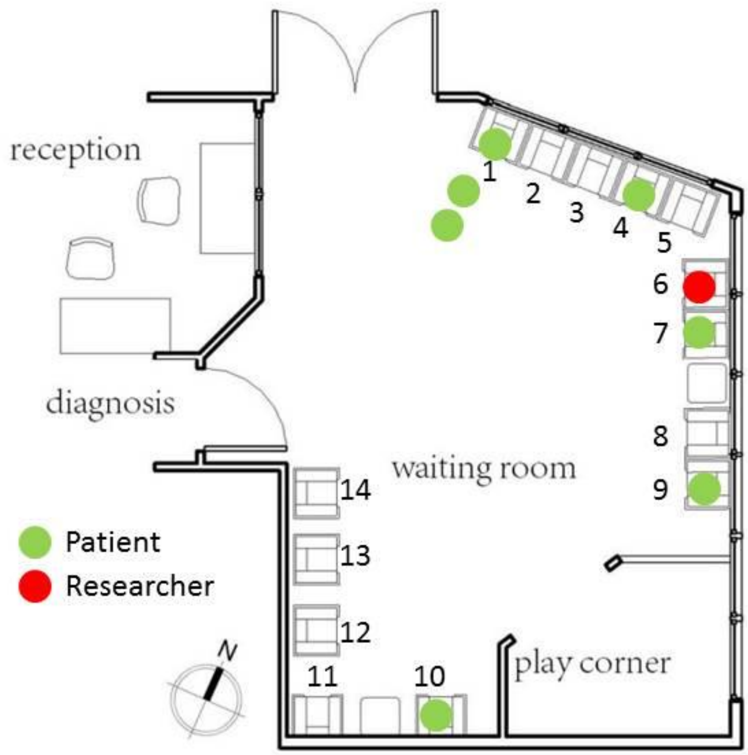


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Figure 4.2 Seating choice in Room A, 10:40am-12:00pm, November 18, 2013

Table 4.2 Seating options in Room A

		Researcher in seat 6	Researcher in seat 11	Total	
	Seat Number	Number of Users	Number of Users	Number of Users	Percentage
Near the Windows	1	3	9	12	0.18
	2	0	8	8	0.12
	3	0	3	3	0.05
	4	1	2	3	0.05
	5	0	6	6	0.09
	6	0	5	5	0.08
	7	1	8	9	0.14
	8	0	6	6	0.09
	9	1	6	7	0.11
	Sub Total	6	53	59	
Away from the Windows	10	1	0	1	0.02
	11	0	0	0	0.00
	12	0	3	3	0.05
	13	0	1	1	0.02
	14	0	1	1	0.02
	15	0	0	0	0.00
	16	0	0	0	0.00
	17	0	0	0	0.00
	18	0	0	0	0.00
	Sub Total	1	5	6	
	Total	7	58	65	

In Room A during the sessions the researcher moved to seat 11, nine out of the users (N=58) chose seat 1. Eight chose seat 2. Another eight chose seat 7. Six chose seat 8. Another six chose seat 8. (See Figure 4.3, 4.4)

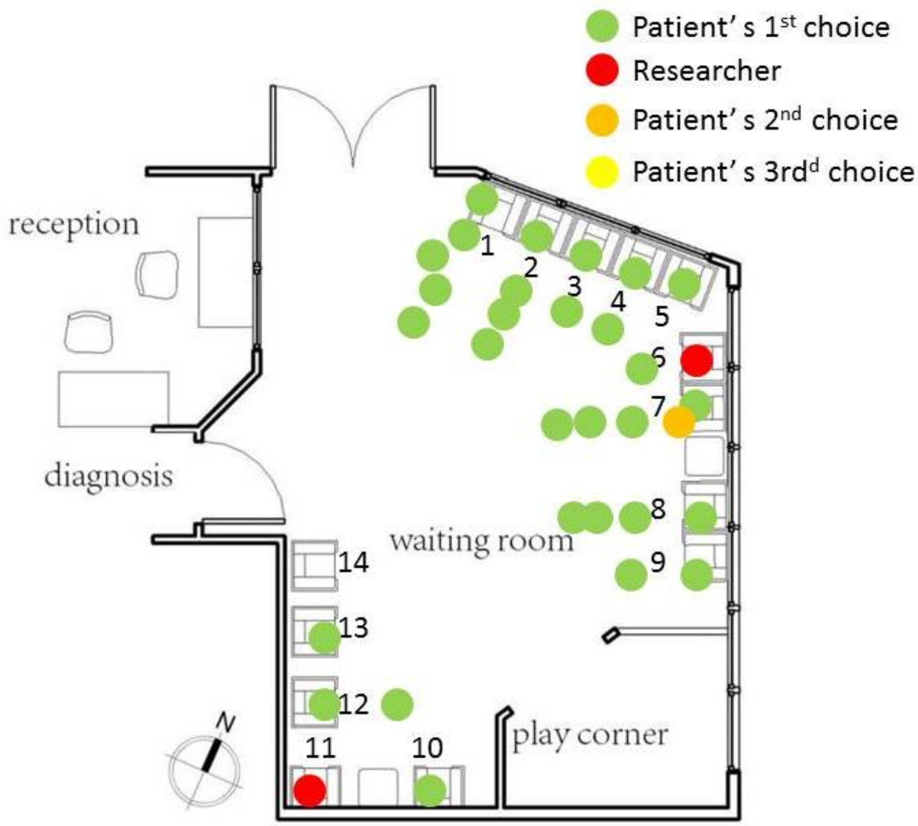

Figure 4.3 Seating choice in Room A, 12:00-3:10pm, November 18, 2013

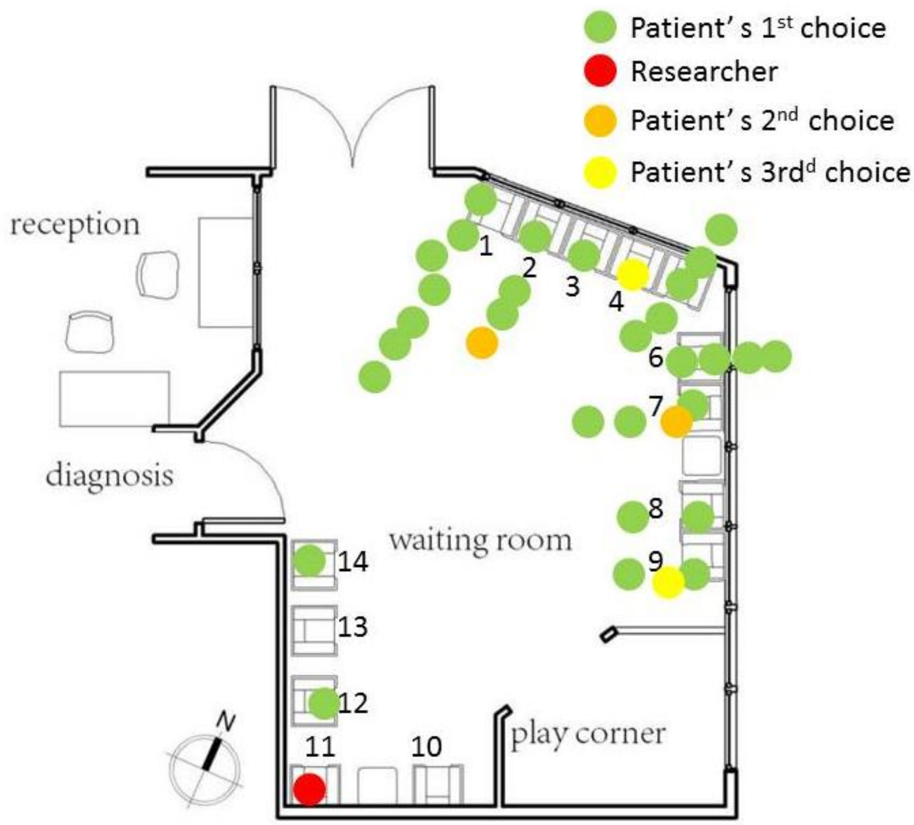

Figure 4.4 Seating choice in Room A, 8:25am-3:25pm, November 19, 2013

In total, the users in the second room (N=65) demonstrated a preference for the seats next to the window. When adding the number of individuals located near the window, 90.77% of the total selected these seats. Overall, seat 1 was most popular, followed by seats 2 and 7. (See Table 4.2)

In Room B, most of the children went into the toy room to play with video games. The four that sat down didn't show any pattern of their seating preference. (Refer to Figure 4.5, Table 4.3.)

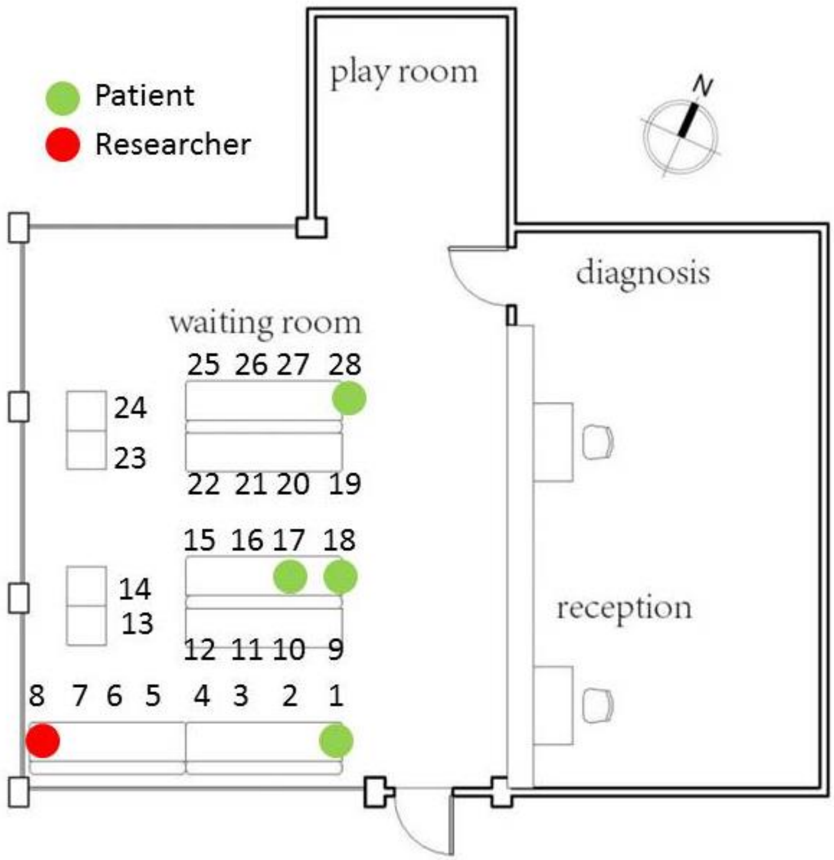

Figure 4.5 Seating choice in Room B, 9:30am-3:00Pm, November 20, 2013

Table 4.3 Seating options in Room B

Seat Number	Number of Users	Percentage
1	1	25.00%
2	0	0.00%
3	0	0.00%
4	0	0.00%
5	0	0.00%
6	0	0.00%
7	0	0.00%
8	0	0.00%
9	0	0.00%
10	0	0.00%
11	0	0.00%
12	0	0.00%
13	0	0.00%
14	0	0.00%
15	0	0.00%
16	1	25.00%
17	0	0.00%
18	1	25.00%
19	0	0.00%
20	0	0.00%
21	0	0.00%
22	0	0.00%
23	0	0.00%
24	0	0.00%
25	0	0.00%
26	0	0.00%
27	0	0.00%
28	1	25.00%

4.1.2 Behavior List

As summarized in Chapter 3, Methodology, the literature review suggested six primary behaviors that should be considered for observation in the waiting room. Those behaviors were crying, yelling, hitting, pacing, smiling and moving towards the window. (See Figure 3.2 in Chapter 3.). The Pilot Study resulted in modifications to this list.

During the Pilot Study, the researcher was not able to use the portable observer device that would allow observing within closer distance. The researcher borrowed the behavior types from the observational study conducted by Nanda et al. (2012) such as pacing and sleeping. However, these behaviors mainly happen to adults and did not occur during the Pilot Study.

Changes included the exclusion of “pacing” and “moving to the window” from the Main Study because during the Pilot Study because these two behaviors only happened a limited number of times. “Smile” was also excluded because this behavior happened to quickly and subtly for the researcher has to accurately record. This behavior was replaced by laughing because due to the small size of the room the researcher is able to hear when a child giggles or laughs. (Refer to table 3.4.)

Table 4.4 Revised behavior list

Uncomfortable Behaviors	Crying
	Yell or Shout (Chalmers, Olson, & Zurkowski, 1999)
	Fight or even hit (Chalmers, Olson, & Zurkowski, 1999)
	Fidget (Nanda et al., 2012)
	Get out of the seat/ toy corner (Nanda et al., 2012)
	Get impatient and talk to parents
Comfortable Behaviors	Laugh
	Run Happily
	Speak/Make funny sounds to oneself
	Singing

4.2 MAIN STUDY

The quantitative results analyses were conducted in three parts: 1) graphic summaries and descriptive tests of the independent variables 2) Student t-tests and correlation tests to test the hypotheses, and 3) additional analysis of the different types of behaviors.

4.2.1 Normality Tests for Independent Variable

To test the normality of the data to determine the appropriate test and to predict the estimate the parametric of the results, descriptive tests including Q-Q plots and diagrams were used to demonstrate the normality of the data. The light measurement in Room A showed a slight trend toward a normal curve. Light measurement and all the behavior frequencies in Room B did not reflect a normal curve. Therefore, non-parametric statistical tests were chosen for the data analysis at both sites.

4.2.2 Correlation of Light Levels and Behavior Frequency

The following sections describe the results as they apply to the specific hypotheses associated with the dissertation research. Four hypotheses were proposed as follows. Due to the large difference between the light measurements of the two rooms, the analysis of each site was conducted separately. The Spearman rho test was used to test the correlations between light levels and behavior frequency.

Hypothesis I: More negative behaviors are associated with higher light levels.

Overall, the results showed the trends that supported the hypothesis. Significant negative correlation showed between the light levels and the average crying duration (-.259, p=.000). Significant negative correlation showed between light levels and the average occurrence of children getting fugitive (-.429, p=.000). A significant negative correlation also showed between light levels and the average occurrence of the all negative behaviors (-.196, p=.003).

A negative correlation was also found between the light levels and the other types of the negative behaviors, although not statistic significant, such as getting impatient and starting to talk to parents (-.018, p=.783).

No significant negative correlations were shown between the light levels and the average occurrence of children fighting, getting out of the seat, or shouting. (See Table 4.5).

Table 4.5 Correlation test result between light levels and negative behaviors

	Cry Duration	Fight	Speak to Parents	Get out of seats	Fidget	Shout	Total Negative
Correlation Coefficient	-.259**	.097	-.018	.043	-.429**	.210**	-.196**
Sig. (2-tailed)	.000	.148	.783	.515	.000	.002	.003
N	226	226	226	226	226	226	226

Hypothesis II: More positive behaviors would be associated with higher light levels.

Significant positive correlation was found between light levels and the average occurrence of children making cute sounds or speaking to self (.178, p=.007). A positive correlation was also found between the light levels and singing duration (.063, p=.345). This correlation is not statistically significant.

No significant positive correlations showed between the light levels and the average occurrence of children laughing, running, nor the total of all positive behaviors. (See Table 4.6).

Table 4.6 Correlation test result between light levels and positive behaviors

	Sing Duration	Laugh	Run	Cute	Total Positive
Correlation Coefficient	.063	-.266**	-.021	.178**	-.050
Sig. (2-tailed)	.345	.000	.748	.007	.455
N	226	226	226	226	226

4.2.3 Additional Tests

4.2.3.1 Descriptive tests for the behaviors

For the negative behaviors, children cried and fought 197 and 120 times respectively, which accounted for 5% and 3% of all negative behaviors combined. They got impatient and started to talk to their parents 394 times, which accounted for 9% of behaviors. The total number of times shouting behavior was observed was 818, which accounted for 13% of behaviors. Children became restless in the seats and got out of their seats multiple times, 1300 and 1570 times, which accounted for 37% and 33% of behaviors respectively. (Refer to Figure 4.6 and 4.7)

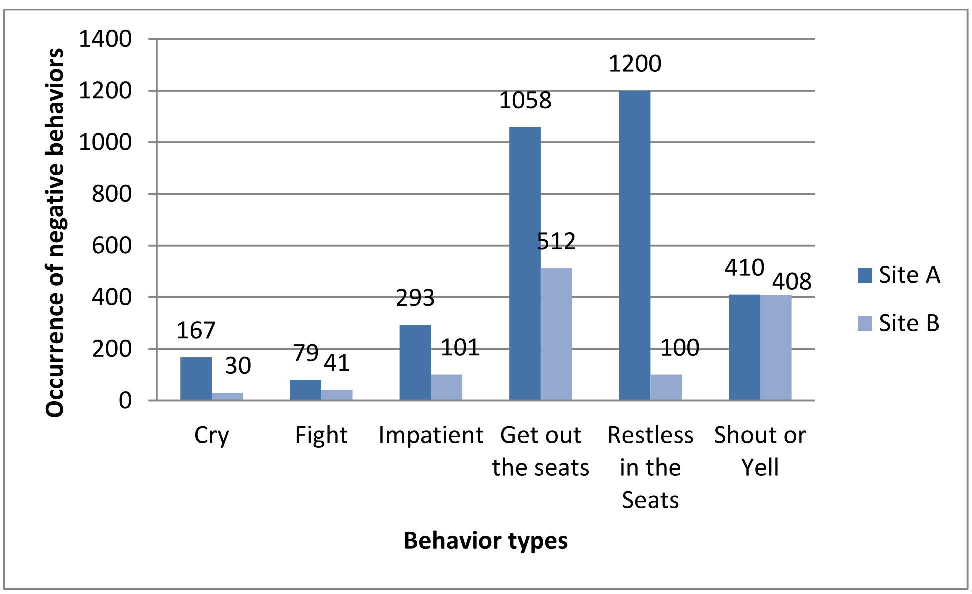

Figure 4.6 Negative behaviors in both rooms

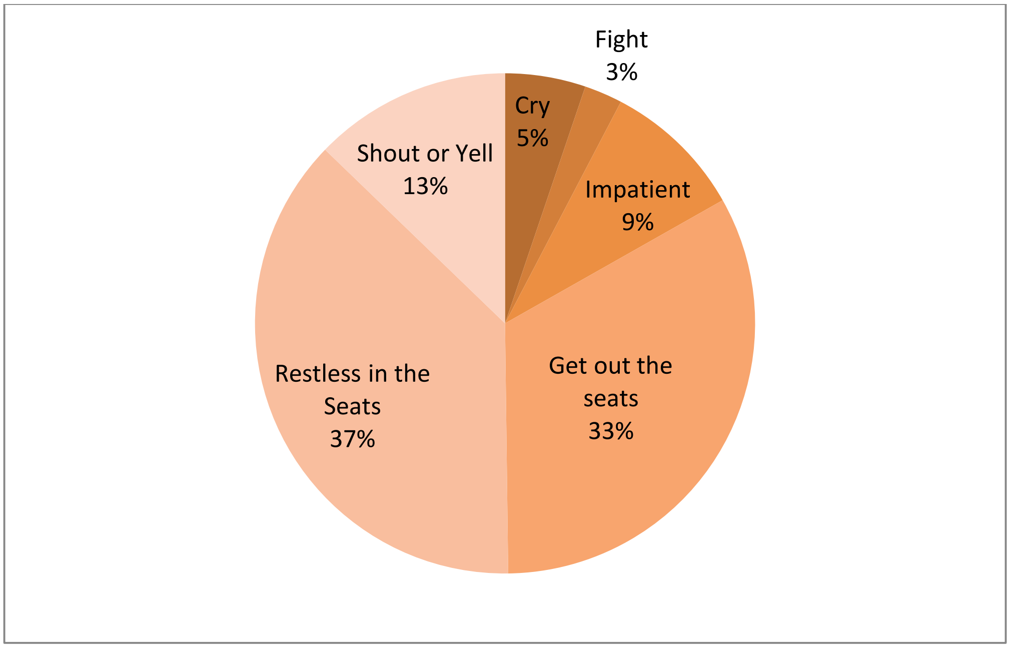

Figure 4.7 Percentage of negative behaviors in both rooms

For the positive behaviors, the children laughed (975 times), ran around happily (1394) spoke to themselves and made funny sounds (799 times) frequently. These activities accounted for 35%, 45%, and 18% of all positive behaviors respectively. They also sang over 80 times in total (2%). (See Figure 4.8, 4.9).

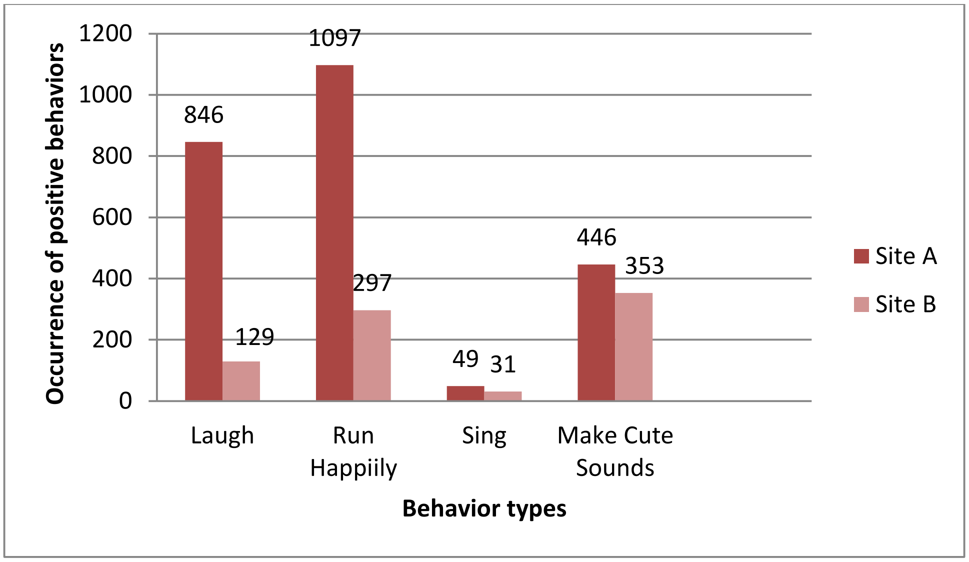

Figure 4.8 Total number of positive behaviors

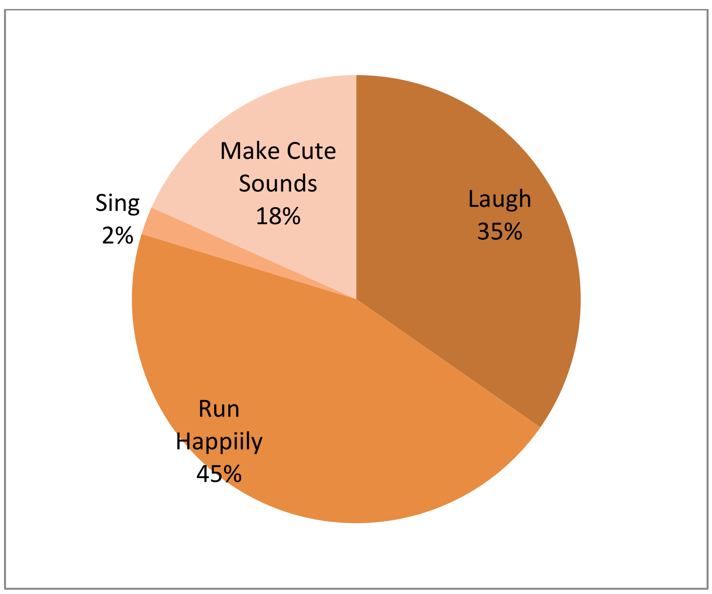

Figure 4.9 Positive behaviors percentage

4.2.3.2 Comparing two sites

Mann-Whitney U test was used to determine the difference between the two sites. Significance differences were detected between mean cry duration, mean occurrence of fighting, fidgeting, shouting, laughing, and making cute sounds.

The test results indicate that the cry duration was significantly longer in Room A than in Room B (U= 4614.5, p=. 000). The test results also indicate that the mean occurrence of fighting was less in Room A than in Room B (U= 5177.5, p=. 033). The test results showed that children fidgeted more in Room A than in Room B (U= 1978.5, p=. 000). Significant difference was also found between children shouting in Room A and in Room B (U= 3756, p=. 000). The test results show that children's laughing happened significantly more in Room A than in Room B (U= 4045.5, p=. 000). It was also indicated that children made cute sounds significantly more frequently in Room B than in Room A (U= 4066, p=. 000). (See Table 4.7 and Table 4.8).

Table 4.7 Negative behaviors between two sites

	Cry Duration	Fight	Speak to Parents	Out	Fidget	Shout	Total Negative
Mann-Whitney U	4614.5	5177.5	5520	5410.5	1978.5	3756	5231
Room A Mean Rank	122.73	108.21	116.4	109.84	141.16	98.27	118.42
Room B Mean Rank	97.6	122.62	108.51	119.81	65.84	139.75	105.02
Asymp. Sig. (2-tailed)	0	0.033	0.355	0.268	0	0	0.138

Table 4.8 Positive behaviors between two sites

	Sing Duration	Laughing	Run	Cute	Total Positive
Mann-Whitney U	5648	4045.5	5467	4066	5605
Room A Mean Rank	111.5	126.71	116.77	100.43	115.8
Room B Mean Rank	116.95	90.74	107.87	136.01	109.53
Asymp. Sig. (2-tailed)	0.398	0	0.322	0	0.487

4.2.3.3 Correlation among the behaviors

The Spearman Rho test was used to test the correlation among the behaviors. Significant correlation was found between cry duration and most of the other negative behaviors. Significant correlations were found between cry duration and getting impatient and starting to talk to parents (.142, p=.033). Significant correlations were also found between cry duration and fidgeting (.227, p=.001). Significant correlation was also found between cry duration and shouting (.161, p=.015). Significant correlation was also found between cry duration and total negative behaviors (.416, p=.000).

Significant correlations were found between fighting and most of the other negative behaviors. A significant correlation was found between fighting and getting impatient and starting to talk to parents (.143, p=.032), between fighting and getting out of seat (.145, p=.029), between fighting and shouting (.332, p=.000), and between fighting and total negative behaviors (.329, p=.000).

Significant correlations were found between getting impatient and starting to talk to parents and getting out of seat (.138, p=.039), getting impatient and starting to talk to parents and shouting (.138, p=.038), getting impatient and starting to talk to parents and total negative behaviors (.338, p=.000).

Significant correlations were also found between getting out of seat and fidgeting (.275, p=.000), getting out of seat and shouting (.180, p=.007), and getting out of seat and total negative behaviors (.588, p=.000).

Significant correlations were found between fidgeting and total negative behaviors (.632, p=.000) and between shouting and total negative behaviors (.363, p=.000). (See Table 4.9).

Table 4.9 Correlation among negative behaviors

		Cry Duration	Figet	Speak to Parents	Get Out of Seat	Fidget	Shout	Total Negative Behaviors
Cry Duration	Correlation Coefficient	1.000	.091	.142*	.069	.227**	.161*	.416**
	Sig. (2-tailed)		.172	.033	.299	.001	.015	.000
	N	226	226	226	226	226	226	226
Fighting	Correlation Coefficient	.091	1.000	.143*	.145*	.008	.332**	.329**
	Sig. (2-tailed)	.172		.032	.029	.900	.000	.000
	N	226	226	226	226	226	226	226
Speak to Parents	Correlation Coefficient	.142*	.143*	1.000	.138*	.109	.138*	.338**
	Sig. (2-tailed)	.033	.032		.039	.104	.038	.000
	N	226	226	226	226	226	226	226
Getting out of seat	Correlation Coefficient	.069	.145*	.138*	1.000	.275**	.180**	.588**
	Sig. (2-tailed)	.299	.029	.039		.000	.007	.000
	N	226	226	226	226	226	226	226
	Correlation Coefficient	.227**	.008	.109	.275**	1.000	-.085	.632**
	Sig. (2-tailed)	.001	.900	.104	.000		.202	.000
Fidget	N	226	226	226	226	226	226	226
Shouting	Correlation Coefficient	.161*	.332**	.138*	.180**	-.085	1.000	.363**
	Sig. (2-tailed)	.015	.000	.038	.007	.202		.000
	N	226	226	226	226	226	226	226
Total Negative Behaviors	Correlation Coefficient	.416**	.329**	.338**	.588**	.632**	.363**	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	226	226	226	226	226	226	226

As for the positive behaviors, significant correlations were found between sing duration and running (.202, p=.002), between sing duration and making cute sounds and speaking to self (.336, p=.000), and between sing duration and total positive behaviors (.342, p=.000).

Significant correlations were found between laughing and running (.306, p=.000), between laughing and making cute sounds and speaking to self (.135, p=.042), between laughing and total positive behaviors (.635, p=.000). Significant correlations were found between running and making cute sounds (.312, p=.000), between running and total positive behaviors (.732, p=.000) and between making cute sounds and total positive behaviors (.597, p=.000). (See Table 5.0).

Table 4.10 Correlation among positive behaviors

		Sing Duration	Laughing	Running	Making Cute Sounds	Total Positive Behaviors
Sing Duration	Correlation Coefficient	1.000	.077	.202**	.336**	.342**
	Sig. (2-tailed)		.251	.002	.000	.000
	N	226	226	226	226	226
Laughing	Correlation Coefficient	.077	1.000	.306**	.135*	.635**
	Sig. (2-tailed)	.251		.000	.042	.000
	N	226	226	226	226	226
Running	Correlation Coefficient	.202**	.306**	1.000	.312**	.732**
	Sig. (2-tailed)	.002	.000		.000	.000
	N	226	226	226	226	226
Making Cute Sounds	Correlation Coefficient	.336**	.135*	.312**	1.000	.597**
	Sig. (2-tailed)	.000	.042	.000		.000
	N	226	226	226	226	226
Total Positive Behaviors	Correlation Coefficient	.342**	.635**	.732**	.597**	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	226	226	226	226	226

4.3 OBSERVATION DIARY

The main observations were carried out from February 20, 2014 to March 14, 2014. Detailed transcripts are provided in the diary summary in Appendix I. While reviewing the diary, additional thoughts of the researcher about the experience were added to the summary provided below.

4.3.1 Distractions

The TVs were off during the Main Study. The views from the waiting room are primarily of bushes and a parking lot. Many children used electronic devices, which helped distract and entertain the children. However, after 10-30 minutes the children became restless. The time after which the children become restless varied depending on each child. The researcher assumed that this restless activity was the result of boredom.

4.3.2 Running and Yelling Behaviors

In Site A, the children started running around or yelling when other children started to do so. In Room B, most children went directly to the video game room. No children ran around or made a lot of noise.

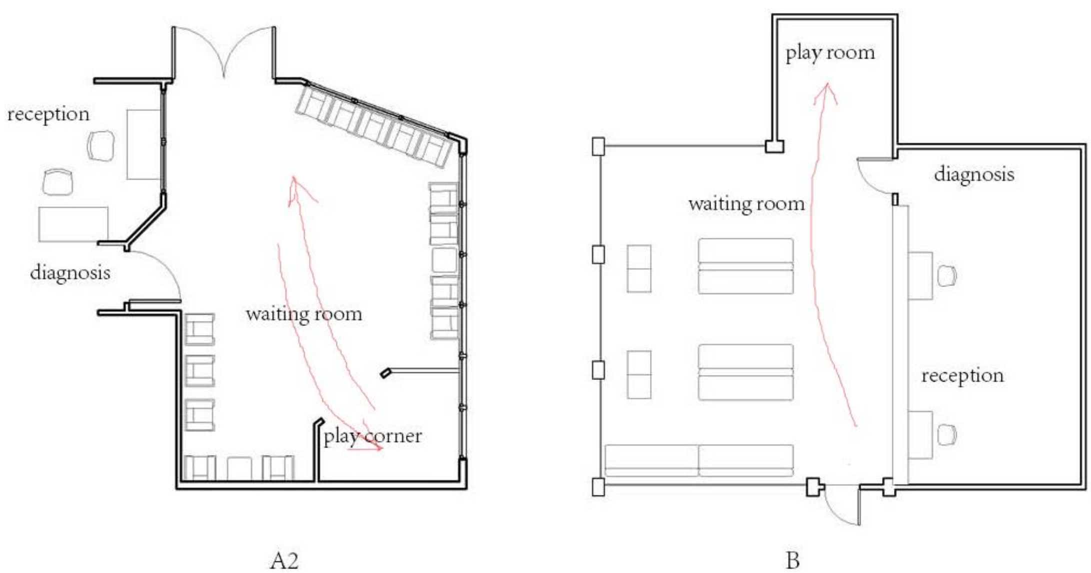

Figure 4.10 Children's running paths

4.3.3 Interaction with Parents

In Site A, parents seemed more attentive to the children. When the parents played with the children, the children became happy and laughed even though they were sick and not feeling very well. In Room B, the parents appeared to be less attentive to the children. Many parents gave the children electronic devices while they interacted with their cellular phones.

4.3.4 Working Environment for Staff

Room B is a lot brighter and quieter than Site A. The patients in Room B seemed happier. The staff in Room B also seemed happier and less stressed than their counterparts in Site A. However, staff complained about glare in the morning.

CHAPTER V

DISCUSSION

The results discussed in this chapter are from the context of the previous chapter. This chapter is divided into two parts: the Pilot Study and the Main Study.

5.1 PILOT STUDY

The observation notes during the Pilot Study showed that the majority of the patients chose to sit next to the windows. This agreed with the previous studies. According to Gessaroli, Santelli, di Pellegrino, and Frassinette (2013), people have seating preferences and adjust positions and distance during social interactions. While the results in Room B did not show any patterns, perhaps due to the lack of patients using the waiting room, patients in room C (n=10) and patients in room A (n=60) both showed significant preference for seats next to the windows. This result resembles the results of Kilic and Hasirci (2011) who found that 56% of the participants preferred to sit near the window.

The reason the patients preferred to sit closer to windows could have been affected by their preference for nature views. A preference for access to nature has been discussed by multiple researchers (Eisen, 2006; Eisen, Ulrich, Shepley, Varni, & Sherman, 2008; Nanda, Eisen, Zadeh, & Owen, 2011; Nanda et al., 2012; Shepley, Fournier, & McDougal, 1998; Ulrich, 1984; Ulrich et al., 1991). This is reflected in their preference for window seating which has a role in the access to nature.

The results could also have been affected by the big percentage of the seats that were close to the window or if the other seats were already occupied. They might not choose the seats they preferred even if the seats within the diameter of their comfort personal circle were occupied.

5.2 MAIN STUDY

5.2.1 Hypotheses

Behavior counts and light levels were analyzed in SPSS 21 (IBM Statistical Package for the Social Sciences). Spearman Rho was used for the correlation tests. Mann-Whitney U test was used to detect the difference between the two rooms.

Overall, the results were pointing to the direction of the hypotheses. Significant correlation was found between light levels and a few behaviors. The results indicated that children showed more negative behaviors when the rooms were dark and more positive behaviors when the rooms were brighter.

The waiting time of each patient, the patients' conditions, and the demographic difference of the patients may have affected the results. The digital devices and the video game machines may also played a role in affecting the behavior frequency.

As argued by Crick and Grotpeter (1995), gender might affect children's aggressive behaviors, both physical and verbal. In a study conducted by Österman et al. (1994), culture and gender were studied as aggressive behavior variables of over 200 children in Finland, Poland, and the United States. Both indirect and direct scales were used to assess children's aggressive behaviors. The results showed significant differences between the different ethnic and gender groups.

The video games in Room B might play a role of provoking children's aggressive behaviors, too, as argued in a few prior studies (Gentile, Lynch, Linder, & Walsh, 2004; Anderson & Bushman, 2001; Silvern & Williamson, 1987). Unfortunately, no information was recorded on the games in the present study.

The children's physical conditions also may have affected their behaviors, as pointed out in Ulrich's environmental conceptual model (Ulrich, Berry, Quan, & Turner, 2010). Unfortunately, the pain levels and other physiological aspects of the patients were not recorded. Future studies are suggested to control the patients' health conditions.

5.2.2 Additional Analysis

As mentioned previously, in addition to the hypothesis exploration, this research served to uncover the nature and types of behaviors that take place in children's waiting rooms. This information was intended to support the work of future researchers. Additional analysis was conducted to detect potential association between light and each behavior.

The mean of total occurrence of both positive and negative behaviors in Site A is significantly bigger than at the second site. The greater mean of the positive behaviors might be caused by the attentiveness of parents and the spacious playing space.

The greater mean of negative behaviors might have been caused by the patients' health conditions: Site A was a general clinic; Room B was a dental clinic. The parents in the Site A generally initiated more interaction with their children. Their playing with the children (e.g., tickling them) may have increased the number of positive behaviors counts on a cloudy day.

5.3 DESIGN RECOMMENDATIONS

5.3.1 Design for Pediatric Patients

While the study results were inconclusive, the study gave rise to several design ideas which are in agreement with the previous findings in the literature. Based on the study results and previous findings in the literature, the researcher suggested the value of the following design recommendations, which may also serve to provide guidelines for pediatric patient waiting rooms.

5.3.1.1 Lighting

Natural light is suggested to provide feelings of well-being and stress-reduction. However, when the light level is too high it may cause discomfort. According to a hospital lighting-technical report, hospital reception and office areas require at least 400 lux (Illuminating Engineering Society, 1968). According de Boer and Fischer's book, office workers found the most comfortable light level to be the range between 1000 lux and 4000 lux, (1981, p. 30). Glare also made the subjects uncomfortable and should be reduced.

5.3.1.2 Noise control

Noise should be controlled in the waiting room to allow infants to sleep and to keep the older children calm. As argued by Alcock et.al. (1985), the children's waiting area was quiet 30% of the time compared to the general hospital that was quiet 75% of the time. Patient and family members' satisfaction may be increased by reducing both children and their family members' agitated behaviors and the noise they generate through the negative behaviors. Play areas should be separate or enclosed with sound proof materials such as sound-absorbing ceiling tiles (Zimring, Joseph, & Choudhary, 2004).

5.3.1.3 Access to nature

Windows can be a method of access to nature (Shepley, Fournier, & McDougal, 1998, p. 153). The subjects showed strong interest in the seats next to the windows and the view outside the windows. In future waiting room design, direct access to nature such as a garden or a patio adjacent to the waiting room is recommended. This agrees with the argument by Rodiek (2002) and colleagues (Rodiek, Nejati, Bardenhagen, Lee, & Senes, 2014) that outdoor garden has stress-reducing impact or older adults.

Children were observed to be staring out of the window. Previous studies suggest patient's preference of nature views (Ulrich & Gilpin, 2003; Nanda, Eisen, & Baladandayuthapani, 2008). Previous studies also suggested children's preference for nature images (Eisen, 2006). Windows with views of nature should be provided in future pediatric waiting rooms. Nature views or nature pictures should also be provided as positive distractors, as many former studies have suggested (Dellinger, 2009; Shepley, 2006).

5.3.1.4 Safety

A lot of children were running in room A where there was a spacious area in the middle of the room. The running not only is dangerous for children but also caused chaos and noise. The waiting rooms should prevent large spaces or long paths that may encourage running. The doorway as an example of a barrier to residents' physical activity was indicated by Rodiek and colleagues in their study in a senior residence facility (Rodiek, Lee, & Nejati, 2014). Also, floor finishes should use non-slippery material while furniture should have rounded corners in order to prevent injury.

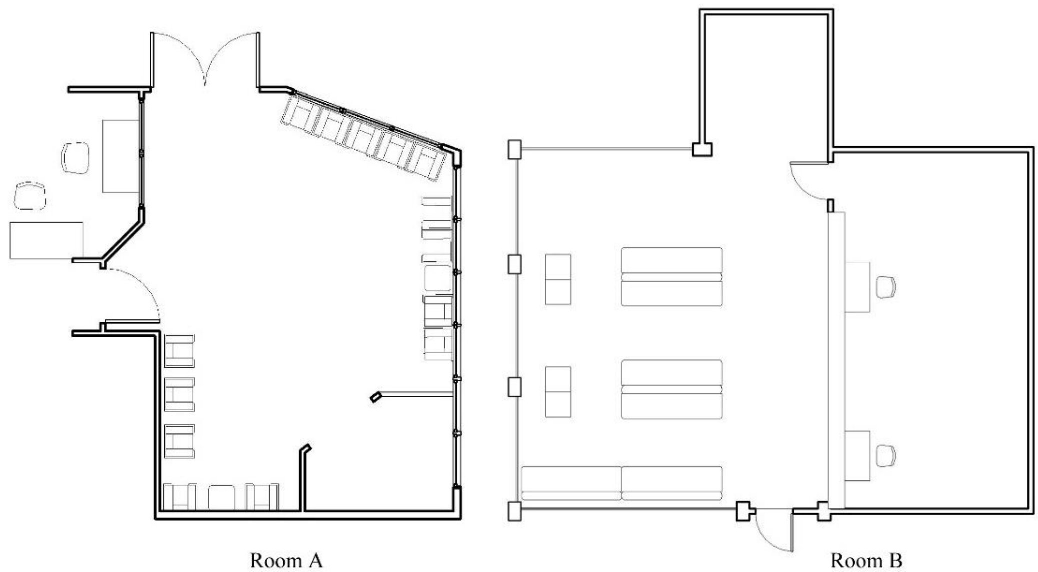

Figure 5.1 Original furniture arrangements

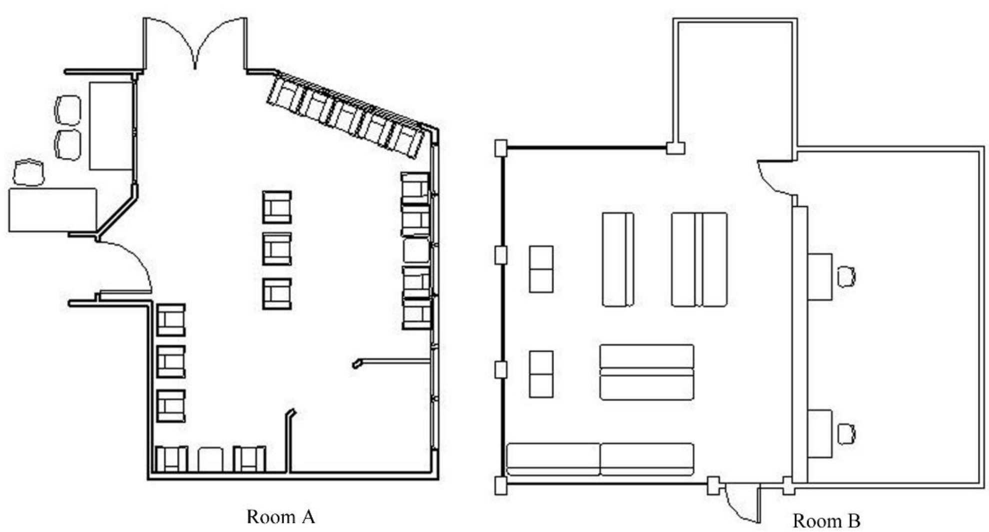

Figure 5.2 New furniture arrangement help preventing running

5.3.1.5 Art

Art can be used as an interior intervention. Nanda and colleagues (Nanda, Eisen, & Baladandayuthapani, 2008) conducted a survey on children's art preferences in patient rooms among 67 hospital inpatients, 75 interior design students, and 50 building science/ architecture students. The subjects were asked how they felt about the pictures and whether they would put the pictures in their rooms. The results showed that the patients' ranking of realistic natural pictures was significantly more positive, while their counterparts among healthy art students ranked them lower.

As for full-size original artwork as compared to photo-sized copies, Farley & Weinstock (1980) found that 5 to 10- year-olds preferred less complex art work and full-sized original artwork. Simmons found a similar result in another study in which young children's art preferences were studied. Sixty children were showed 200 pictures and the results show younger children tended to prefer artwork with less complexity than older children (Simmons, 1994).

In the present study, no art was used in the patient rooms. Art with calming nature images should be used in future waiting rooms to provide children patients an anxiety–free environment.

5.3.2 Design for Family Members

5.3.2.1 Parent proximity to children

Based on the observations, interaction with parents affects children's patience level. Therefore, seating and space that allows parents to be close to and have interaction with the children are suggested. During the observation, interaction with parents was noted to have a positive impact on children's happiness and waiting satisfaction. This research suggests the need to design waiting rooms with features that encourage interactions with parents. As suggested in previous studies, parental presence decreases the child's fear (Cavender, Goff, Hollon, & Guzzetta, 2004), relieves pain (McMurtry, Noel, Chambers, & McGrath, 2011), and helped children wait more patiently (Alcock et al., 1985).

5.3.2.2 Provide seating options

Crowding may cause stress (Singer & Baum, 1983), due to its impact on privacy. Patients need their privacy protected (Zimring, Joseph, & Choudhary, 2004). Family-friendly and homelike environments are suggested as a means of providing patients with a consistent and comfortable ambience (Fottler, 2000). Future pediatric waiting rooms are suggested to provide seating options to family members to promote their waiting satisfaction.

5.3.3 Design for Medical Staff

5.3.3.1 Design restorative working environment for nurses

Medical errors are one of the leading causes of death in the United States (Kohn, Corrigan, & Donaldson, 2000). When we design healing environments, we have to take staff needs into consideration. As Pati and Barach argued (2010, p. 7), nurses are frequently stressed and fatigued, which may lead to poor patient care. It is vital to design environments that have stress-reduction and restoration effects on staff and thus reduce medical errors. As argued by Kohn, Corrigan, and Donaldson, the errors can be prevented (2000, p.5). A comfortable environment also promotes communication between staff and patients which in turn promotes patient satisfaction and reduces children's fear and stress (William, 2009).

Combining the literature and the observation, windows and natural light are strongly suggested for staff's working environment. Excessively high levels of light and glare need to be prevented. This agrees with the study results of Zadeh and colleagues, although not statistically significant, medical errors occurring in the wards with windows and daylight were only one fifth of those that happened in the wards without windows. (2014).

5.3.3.2 Control noise

Both Ulrich's review and Shepley's study discuss the negative effect of noise on medical staff. Based on the results of the observation, in pediatric waiting areas, high levels of noise were generated by children while they were crying, shouting, running, and playing. It is vital to control noise level in the waiting rooms to provide staff a better working environment.

A summary of the above guidelines is provided in Figure 5.3.

DESIGN FOR PEDIATRIC PATIENTS

- Design waiting rooms with windows to provide natural light and the feeling of access to nature.
- Keep the illumination level reasonable since excessive light levels were tested to have negative effect on children's behaviors.
- Adopt nature window view, nature pictures, and indoor plants to reduce children's stress and fear.
- Control the noise level to reduce children's stress and protect infants' sleep.
- Eliminate children from running inside of the waiting rooms.
- Use child proof furniture and indoor finishing materials.
- Avoid abstract pictures or pictures with contents that may scare children.

DESIGN FOR FAMILY MEMBERS

- Provide space for family members to interact with children.
- Provide seating options to provide family members to promote waiting satisfaction.

DESIGN FOR MEDICAL STAFF

- Create a restorative working environment for medical staff by adopting windows and daylight.
- Control noise level to reduce staff's stress levels and maintain better physiological conditions.

Figure 5.3 Implication for practice

CHAPTER VI

CONCLUSION

6.1 SUMMARY

This chapter concludes the dissertation by summarizing the study background, methods, findings, limitations, and suggestions for further research.

6.1.1 Summary of the Background

Evidence-based research is critical for helping designers, facility managers, and medical staff to improve their design process and health care. Previous research indicates the significance of the built environment for health, and suggests that healthcare settings play a major role in patients' healing outcomes as well as on family and staff satisfaction, and staff working efficiency. For example, window views were found to have positive benefits in relieving patients' stress and pain, while shortening patients' length of stay; natural light has been found to reduce stress and improve mood.

6.1.2 Summary of the Methods

This study aimed to answer the questions: how can we build better pediatric waiting areas with better lighting design? To answer this question, the study investigated the impact of daylight on children's behavior in pediatric waiting rooms using both qualitative and quantitative methods. The light levels were measured at the beginning of every 30-minute observation session. Children's behaviors were counted and analyzed with Student t-tests and Spearman's correlation tests. Notes on unexpected environmental changes or children's behaviors were written into an observational diary.

The results were anecdotal, but suggest that lighting design in pediatric areas affects children's behaviors. The researcher reflected that the children's behaviors potentially affect patients' perceptions and staff working satisfaction.

6.1.3 Summary of Findings

The findings included two phases of the study: Pilot Study and the Main Study. During the Pilot Study, it was found that 91% of the patients in Room A chose to sit near the windows. In the Main Study, children showed significantly longer crying, more fidgeting, and more negative behaviors all together with lower light levels. Children also showed a trend of becoming impatient and starting to talk to parents more frequently when the rooms were darker. By contrast, children showed more positive behaviors such as singing and making cute sounds when the rooms were brighter.

6.2 LIMITATIONS

Due to time and financial constraints, the present study was conducted with limitations in sample, sites, environment control, and tools.

6.2.1 Sampling Strategy

The study used convenience sampling techniques and a small number of sites in a single geographic region. Due to the practical issues and the intension to gather data as naturally as possible, the researcher observed the children who came to the clinics during the observation. Because cultural and sociodemographic characteristics of clinics, subjects, and their parents vary in different settings and influence study results (Alaniz & Gilly, 1986; Fuligni, 2001; Fuligni, Tseng, & Lam, 1999; Shepley & Song, 2014), future studies could reach out to a wider range of settings and randomly select the sites.

6.2.2 Control the Environment

To eliminate the interaction or interferences with the patients and their families, the observations were carried out in the waiting rooms with no control of the environmental factors such as the interior furnishings. There were times in which the electric lights were turned on by the facility staff while the rooms were dark. Therefore, the light level readings that were measured and recorded during those times were the illumination contributed both from daylight and the artificial lights. Another example of the factors that were not controlled was the blinds. During the observation the researcher could not control the sunlight or window views when the staff shut the blinds. Blinds or curtains, on the other hand, could be a blocker of the natural light or window views in a future quasi-experiment study. For example, patients' preference for sunlight or window views could be investigated by comparing the outcomes with the blinds or curtains open to the outcomes with the blinds or curtains closed.

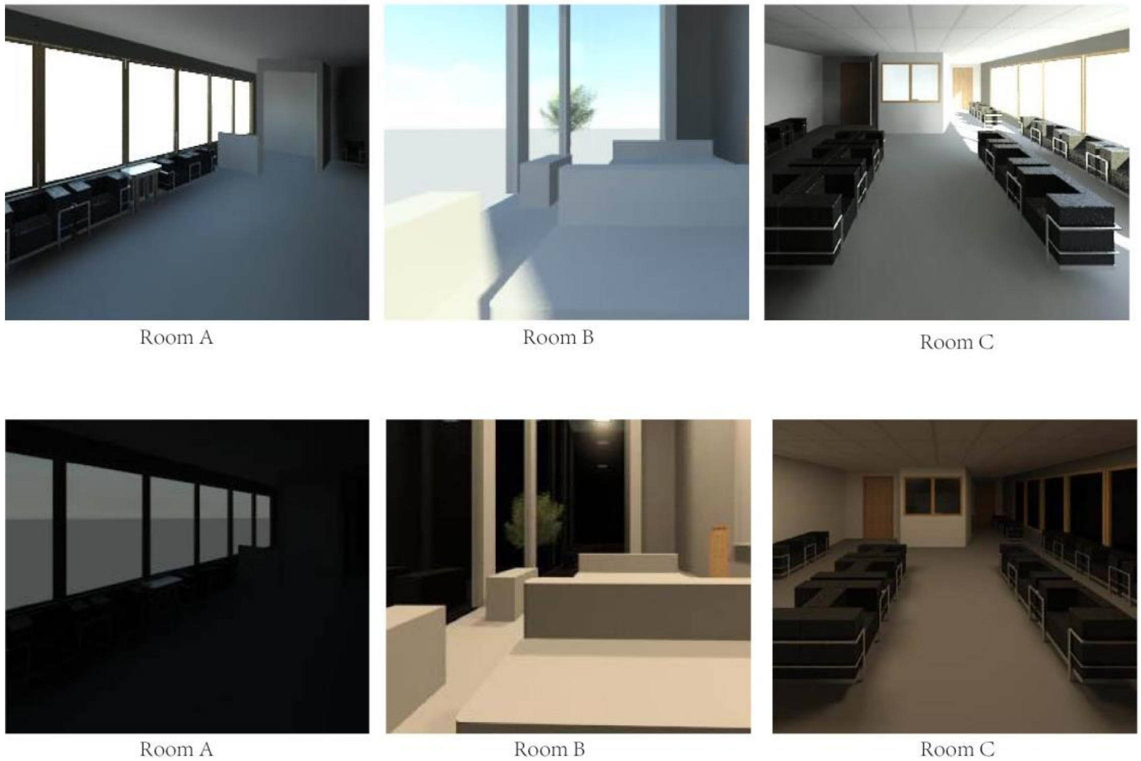

Figure 6.1 Computer simulations of natural light and artificial light

6.2.3 Limitations of Tools and Measurements

The light meter was limited to a capturing single measurement that changed frequently. The meter could not generate nor record continuous data. The light levels were measured at a single location of each room. Measurement examples that were taken at multiple locations in the rooms are shown in Figure 6.2 to Figure 6.5.

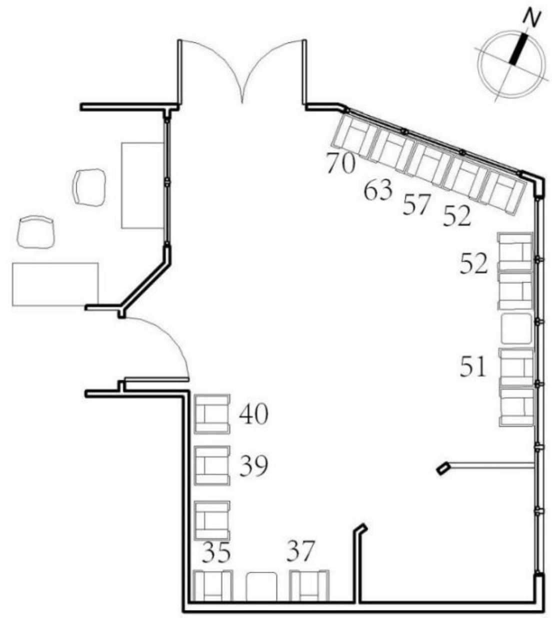

Figure 6.2 Light readings in Room A, 9:30 am

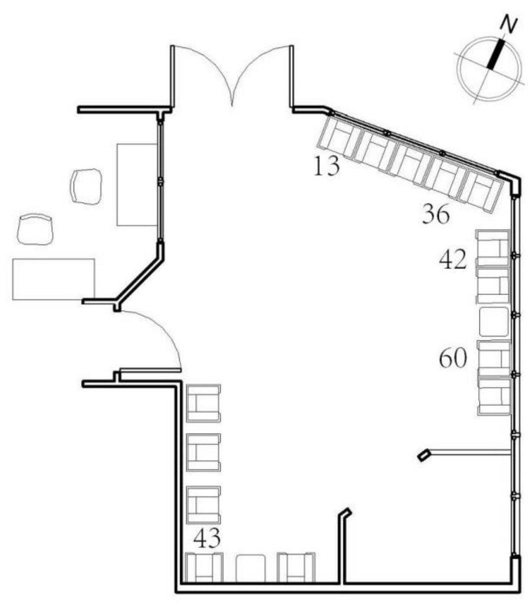

Figure 6.3 Light readings in Room A, 11:50 am

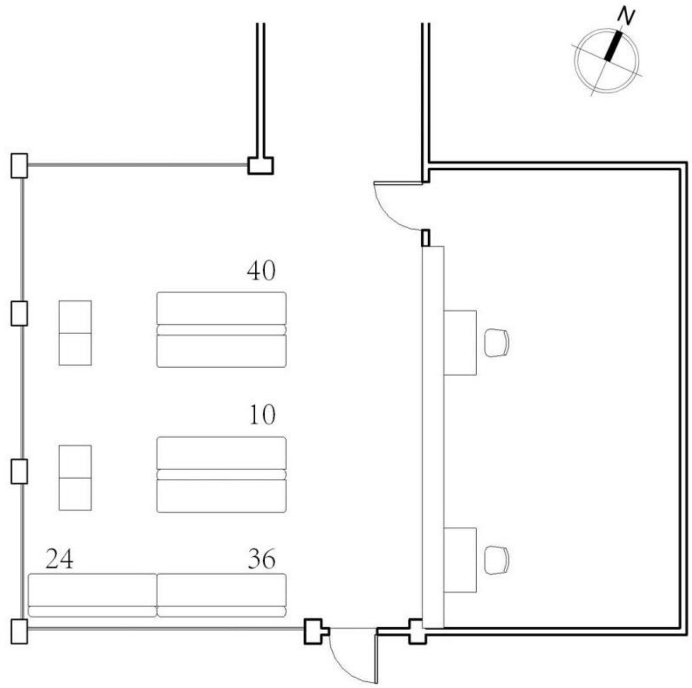

Figure 6.4 Light readings in Room B, 8:34 am

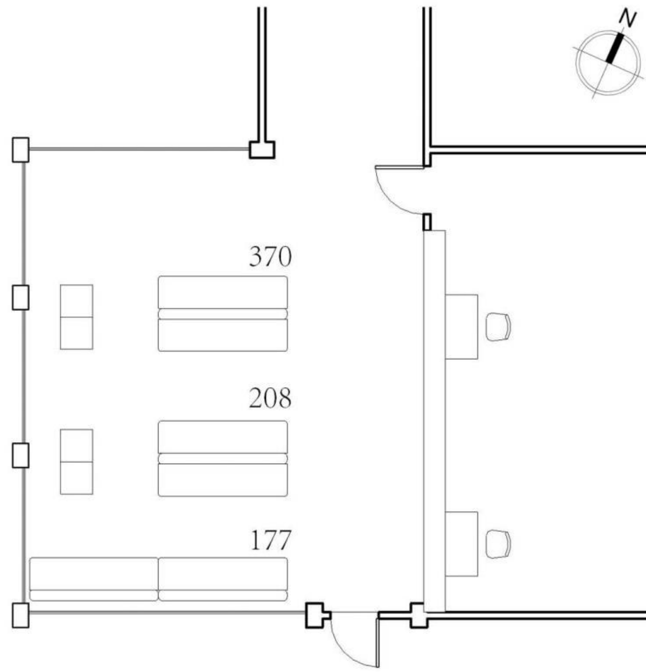

Figure 6.5 Light readings in Room B, 11:09 am

The noise meter used in this study had a similar limit. The meter could only capture peak noise during a limited time frame.

The Noldus Observer XT 10.5 was used to record the children's behavior frequency, which required the researcher to stay in one seat in each waiting room to keep the laptop plugged into the wall outlets during the observation. Therefore the researcher did not have the flexibility to move around in the waiting room to capture certain types of the patients' behaviors nor facial expressions. The latest version of Noldus Observer XT at the time this study was conducted was version 11, which could be installed to more mobile devices such as a tablet or a smartphone.

Children's behaviors were observed continuously within each observation session. There were a few cases when the children's behaviors were cut off because the session was over. The number of these cases were not collected or noted.

6.3 FURTHER RESEARCH

6.3.1 Potential Topics

The present study investigated the impact of daylight on a large variety of children’s behavior types using several methods and tools. However, there is still a vast research gap examining the relationship between the physical environment and pediatric patient healing outcomes. Future studies could further investigate the impact of the built environment on pediatric patients’ behaviors. Staff and parent satisfaction could also be included.

6.3.2 Potential Methodologies

Recommendations for future research also include the use of additional methods and upgraded/more advanced tools. Methods such as focus group and interview could be used to receive more in-depth insights. Additional tools such as sound meters which record continuous sound measurements, light sensors which record accurate light levels at multiple locations simultaneously, and upgraded behavior observing software could be used to achieve more accurate results. Also, more control over environmental variables would support a more sophisticated a quasi-experimental study.

6.4 SUMMARY

The study provided an example of interdisciplinary research, crossing the fields of architecture and psychology. The study expanded the knowledge of the impact of the waiting room environment on children's behaviors. The author provides suggestions for future pediatric waiting room design, such as promoting access to natural light and nature views, providing family space, reducing glare and noise, and adopting child-proof space design and finishing materials. The results can be used to advise future pediatric design.

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APPENDIX A

LIGHT METER MANUAL

EXTECH INSTRUMENTS
A FLIR COMPANY

Experience the Extech Advantage
PRODUCT DATASHEET

Foot Candle/Lux Meter

Accurate light level measurements
Plus analog output for capturing readins to a recorder

Features:

- Accurately displays light level in terms of Fc or Lux over three ranges: Fc (0-200, 0-2000 and 0-5000Fc) and Lux (0-2000, 0-20000, 0-50000Lux)
- Resolution of 0.1Fc or 1Lux with 5% accuracy
- Select fast (1 second) or slow (2 seconds) response
- Monitor light levels using outputs; 1mV per count analog output for capturing readings to a recorder
- Utilizes precision photo diode and color correction filter; Cosine/color corrected
- Dimensions: 6.4 x 2.8 x 1.2" (163 x 70 x 30mm); Weight: 7.8oz (220g)
- Complete with 9V battery

Ordering Information:

401025....................Foot Candle/Lux Meter
401025-NIST ....401025 with NIST Certificate
409996....................Vinyl Pouch Carrying Case

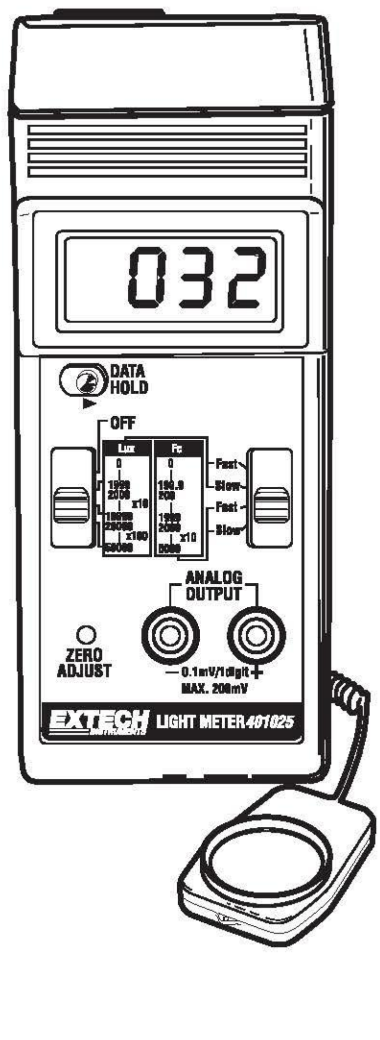
www.extech.com

05/08 - R1

User's Manual

EXTECH INSTRUMENTS
A FLIR COMPANY

Model 401025
Digital Light Meter

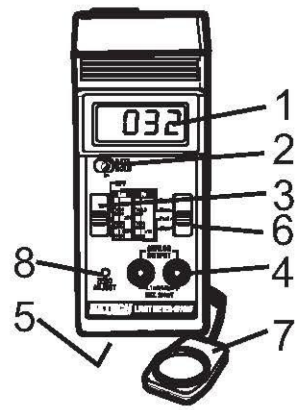


Introduction

Congratulations on your purchase of Extech's Digital Light Meter. This professional meter, with proper care, will provide years of safe reliable service.

Meter Description

1. LCD Display
2. Data Hold Switch
3. Power Off/Range Switch
4. Analog Output Terminal
5. Battery Compartment (rear)
6. LUX/Fc Switch & Response Switch
7. Light Sensor
8. Zero adjust



Operation

1. Select Units (Lux or Ft-candle) and Response Time (Fast or Slow) on the slide switch. Typical selection is Slow and Fc using the gray lettering.
2. Select the maximum range on the "Range Switch"
3. Hold the "Light Sensor" so that the sensor faces the light source to be measured.
4. The Display will indicate measured values. Use a range display multiplier if on the Lux 20,000 and 50,000 ranges or on the Fc 5000 range.
5. To "hold" a measurement, slide the "Data Hold Switch" to the "hold" position. The reading will "freeze" in the display until the "Data Hold Switch" is released.

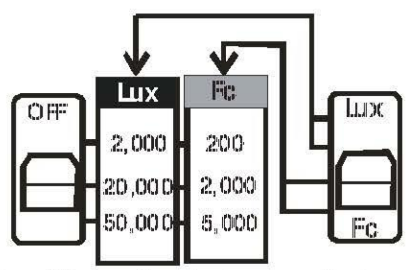
Note 1: An Over Range indication is a display of "I ". If this occurs, switch to a higher range.

Note 2: For measurements made on the Fc 5000 range, the displayed reading must be multiplied by 10.

Note 3: For measurements made on the Lux 20000 or 50000 range, the displayed reading must be multiplied by 10 and 100 respectively.

Note 4: The meter will indicate values above the maximum ranges. The accuracy of these measurements is unknown.

Range Display Multipliers		
Range	**Units**	**Multiplier**
200	Fc	Direct reading
2000	Fc & Lux	Direct reading
5000	Fc	Reading x10
20,000	Lux	Reading x10
50,000	Lux	Reading x100



Example: If a measurement on the 5000 Fc range displays 350, then the actual measured value is; 350 X 10 = 3500 Fc.

Selecting a Measurement Range

The meter has three measurement ranges (0-200, 0-2000, and 0-5000 Fc) and (0-2000, 0-20000, and 0-50000) Lux). The proper range selection will produce the most accurate reading. Always select the range that produces the maximum number of digits without exceeding the maximum count for that particular range. For example, a reading of 1456 Fc should be read on the 0 - 2000 range, not the 0-5000 range.

Zero procedure

The meter zero (display with no light input) may change with time. Occasional checking and adjustment may be required.

1. Completely cover the sensor to block out any light.
2. Set the range switch to the lowest Lux or Fc range
3. Using a small screwdriver, adjust the "Zero" control for a zero display. The last digit may change slightly. This is normal and does not affect the accuracy of the meter.

Analog Output

The analog output jacks on the front panel produce a 0.1mV DC per digit signal that can be used for recording or datalogging purposes.

Lighting Type Correction Factors

The 401025 light meter is calibrated under a precise "Standard tungsten light source of 2856^{O}K". If the meter is to be used under a different type of light the correction factor of from the table below should be applied to the readings obtained.

Mercury Lamp	x1.14
Fluorescent Lamp	X0.92 to 1.12
Daylight	x1.00
Sodium	x1.22
Metal Halide	x1.00

Replacing the Battery

When the left corner of the LCD display shows "LO BAT", it indicates the battery output is below the design limit and the battery needs to be replaced. However, reliable measurement can still be taken for another few hours before the tester becomes inaccurate.

1. Open the Battery Cover at the back of tester and remove the battery.
2. Replace with a 9V battery and install the cover.

You, as the end user, are legally bound (**EU Battery ordinance**) to return all used batteries, **disposal in the household garbage is prohibited!** You can hand over your used batteries / accumulators at collection points in your community or wherever batteries / accumulators are sold!

Disposal: Follow the valid legal stipulations in respect of the disposal of the device at the end of its lifecycle

Specifications

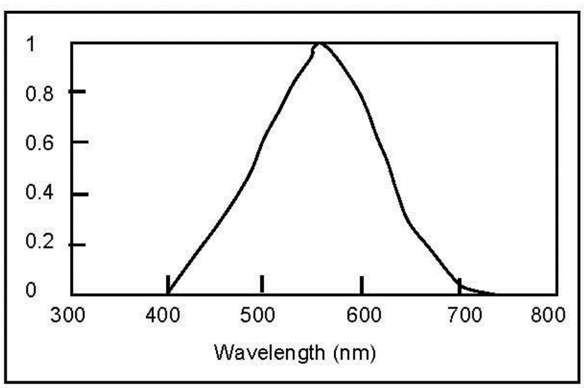
General Specifications

Display	13 mm (0.5") LCD (Liquid Crystal Display).
Measurement	Lux, Ft-candle (Fc).
Ranges	Lux: 0 to 50,000 Lux, 3 ranges. Foot-candle: 0-5,000 Fc, 3 ranges.
Sensor	Exclusive photo diode & color correction filter, spectrum designed to meet C. I. E.
Zero Adj.	Manual adjustment.
Sampling Time	Approx. 0.4 sec.
Response Time	Fast: 0.25s; Slow: 1s
Over input indication	Indication of "1 "
Analog Output	0.1 mV/1 digit, max. output :200mV.
Operating Temperature	0^{O}C to 50^{O}C (32^{O}F to 122^{O}F)
Operating Humidity	Less than 80% RH.
Power Supply	006P DC 9V battery
Power Current	Approx. 2 mA DC
Weight	220 g / 0.52 LB
Dimension	Main instrument: 163x70x30mm (6.4x2.8x1.2 inch). Sensor Probe: 85x55x12 mm (3.2x2.2x0.5 inch).
Optional Accessories	Vinyl pouch carrying case, 409996

Range Specifications

Lux			
Range	**In-range Display**	**Resolution**	**Accuracy (FS)**
2,000 Lux	0-1,999 Lux	1 Lux	± (5% + 2digits)
20,000 Lux	2,000-19,990 Lux	10 Lux	± (5 % + 2digits)
50,000 Lux	20,000-50,000 Lux	100 Lux	±- (5 % + 2digits)
Foot-candle (Fc)			
Range	**In-range Display**	**Resolution**	**Accuracy (FS)**
200 Fc	0-199.9 Fc	0.1 Fc	± (5% + 2digits)
2,000 Fc	200-1,999 Fc	1 Fc	± (5% + 2digits)
5,000 Fc	2,000-5,000 Fc	10 Fc	± (5% + 2digits)

Frequency Spectrum



Appendix A: Typical Light Levels

Lux	Foot Candles		Lux	Foot Candles	
		Factories			**Home**
20-75	2-7	Emergency Stairs, Warehouse	100-150	10-15	Washing
75-150	7-15	Exit/Entrance Passages	150-200	15-20	Recreational Activities
150-300	15-30	Packing Work	200-300	20-30	Drawing Room, Table
300-750	30-75	Visual Work: Production Line	300-500	30-50	Makeup
750-1,500	75-150	Typesetting: Inspection Work	500-1,500	50-150	Reading, Study
1,500-3,000	150-300	Electronic Assembly, Drafting	1,000-2,000	100-200	Sewing
		Office			**Restaurant**
75-100	7-10	Indoor Emergency Stairs	75-150	7-15	Corridor Stairs
100-200	10-20	Corridor Stairs	150-300	15-30	Entrance, Wash Room
200-750	20-75	Conference, Reception Room	300-750	30-75	Cooking/Dining Room
750-1,500	75-150	Clerical Work	750-1,500	75-150	Show Window
1,500-2,000	150-2000	Typing, Drafting			
		Store			**Hospital**
75-150	7-15	Indoors	30-75	3-7	Emergency Stairs
150-200	15-20	Corridor/Stairs	75-100	7-10	Stairs
200-300	20-30	Reception	100-150	10-15	Sick Room, Warehouse
300-500	30-50	Display Stand	150-200	15-20	Waiting Room
500-750	50-75	Elevator	200-750	20-75	Medical Exam Room
750-1,500	75-150	Show Window, Packing Table	750-1,500	75-150	Operating Room
1,500-3,000	150-300	Storefront, Show Window	5,000-10,000	500-1000	Eye Inspection

Appendix B - Common Terms and Conversion Factors

Illuminance (Visible Flux Density)	1 lm/m^2 =	1 lux (lx)
		10^{-4} lm/cm^2
		10^{-4} phot (ph)
		9.290×10^{-2} lm/ft^2
		9.290×10^{-2} foot-candles
Luminance (Visible Flux Density per Solid Angle)	1 $lm/m^2/sr$ =	1 candela/m^2
Luminous Intensity (Visible Flux per Solid Angle)	1 lm/sr =	1 candella
Luminous Flux (Visible Flux)	1 lumen (lm) =	1.464×10^{-3} watts @ 555 nm

APPENDIX B

OBSERVATION DIARY

Pilot Study

11/18/13

Room C

Session 8:00 am ~ 8:30 am
Light Level: 340 Lux
Noise Level: 58 ~ 67 dB
8:20 am
Parents talking loudly, no affection to their children.

Session 8:40 am ~ 9:10 am
Light Level: 200 Lux
Noise Level: 40 ~ 50 dB
8:40 am
TV plays health channel, health advertisement and programs for adults. For example, diet, cooking show. There is no toys or books for children that are waiting in the room.

Session 9:20 am ~ 9:50 am
Light Level: 230 Lux
Noise Level: 43 ~ 55 dB

Session 10:00 am ~ 10:30 am
Light Level: 200 Lux
Noise Level: 47 ~ 56 dB
10:15
Car alarm went off outside the window.
10:20
The fan works loudly.

Room A

Session 10:40 am ~ 11:10 am
Light Level: 480 Lux
Noise Level: 51 ~ 62 dB
10:55
An infant kept crying loudly. A 6 year old boy looked concerned. A 2 year old started crying.

11:00
The infant kept crying loudly. The infant's 3 year old sibling was walking around without looking concerned. A toddler looked into and played with the trash can.
11:10
The TV was playing. One parent is playing music from the cell phone. Patients and parents started talking loudly. Children didn't seem affected at first but three children started crying soon after. The decibel meter's reading is around 76.

Session 11:20 am ~ 11:50 am
Light Level: 250 Lux
Noise Level: 60 ~ 65 dB
11:20
There are no nature pictures on the wall. There are lots of newspaper clips on the wall. The wall looks noisy. It seems like when one child cries other children start crying or screaming. Many young children keep walking and running around. Safety within the waiting area is critical. Safe play areas for children to walk or run might be needed. The TV is showing channels called "Kid Care" with health advertisement and a backpack advertisement.
11:20 -11:50 am
No nature pic
Lots of papers on the wall, look noisy
One kid cry triggered other kids cry or scream
Keep walking & running, safe & spacious playground would be nice.
Kid care TV, health ads, and backpack ad

Session 12:00 pm ~ 12:30 pm
Light Level: 260 Lux
Noise Level: 56 ~ 65 dB
12:00 -12:30 pm
Quite down, children sitting in the seats facing TV kept watching TV
Children stopped watching TV after 10 minutes, started talking & feeling/looking/acting bored, 10 minutes after, started watching TV again
T2P: children initiate talking, excluding p ask qs or discuss things with children
Q: how anonymous, can I tell my families

Session 12:40 pm ~ 1:10 pm
Light Level: 260 Lux
Noise Level: 55 ~ 60 dB
572
The room was very quiet. Children were sitting down and talking. Some laughed and looked out of the window. Some parents came out from the doctor's office, starting catching up with the patients. The room became nosier. Some children became fidget in their seats. Some fussed with their moms. Some hit their younger siblings. 10 minutes after, the room became quieter again. The kids who were still fighting continued

fighting, but in a playful way. They laughed while playfully fighting. A baby came into the room screaming. A boy who was watching TV quietly started talking to his mom.
1:20pm
There were girls in the room. The room was quiet. The girls were forced to do their homework so they were wining.

Session 1:20 pm ~ 1:50 pm
Light Level: 220 Lux
Noise Level: 52 ~ 60 dB
The room was quiet. Two girls were sitting down and waiting quietly. They were also watching TV. They occasionally asked their mom questions.
7-yr old girl asked her mom a lot of questions while there was a birth control advertisement (product name: Neve Ring) on the TV. Her mom became impatient.

Session 2:00 pm ~ 2:30 pm
Light Level: 290 Lux
Noise Level: 63 ~ 73 dB
The room was quiet. The children were sitting down quietly. The child who waited for over 20 minutes started getting fidget and keep getting out of the seat. A 6-yr old boy started watching music vedios on a cell phone.
There were times that the researcher was not able to see smiles on children's faces.
The room was quiet in the next 10 minutes.

Session 2:40 pm ~ 3:10 pm
Light Level: 290 Lux
Noise Level: 56 ~ 63 dB
Some parents were talking. Children were playing with loud toys. The room became noisier.
It was hard for the children to focus and they needed their parents' attentions more when the room was loud.

11/19/13

Room A

Session 8:25 am ~ 8:55 am
Light Level: 230 Lux
Noise Level: 48 ~ 55 dB
Children played with the toys a lot. Parents sometimes watch their children and sometimes played with their children.

Session 9:00 am ~ 9:30 am
Light Level: 210 Lux
Noise Level: 44 ~ 50 dB

The room was quiet. A 6-yr old boy kept talking and playing with his dad. His dad was being attentive. The boy changed into another seat. His dad followed.

Session 9:40 am ~ 10:10 am
Light Level: 250 Lux
Noise Level: 56 ~ 58 dB
The researcher lost track of each child. One child might be identified as two different patients.
When the room became noisier, the children became restless more.
Patients and parents showed preference sitting close to windows. When the TV was on, some patients and parents sat close to TV.

Session 10:20 am ~ 10:50 am
Light Level: 220 Lux
Noise Level: 56 dB
There were girls singing. Some boys were running.
There were some behaviors that the researcher was not able to record.

Session 11:00 am ~ 11:30 am
Light Level: 270 Lux
Noise Level: 53 ~ 63 dB

Session 1:00 pm ~ 1:30 am
Light Level: 270 Lux
Noise Level: 55 ~ 61 dB
There was a 8-yr old boy waiting calmly in the waiting room. The room became louder he was still sitting calmly. But soon after he got out of his seat and started speaking to his mom. He then got into an argument with his mom.

Session 1:40 pm ~ 2:10 pm
Light Level: 240 Lux
Noise Level: 54 ~ 61 dB
The researcher could hear nurses calling the patients' names. This may cause risk of privacy.

Session 2:20 pm ~ 2:50 pm
Light Level: 320 Lux
Noise Level: 56 ~ 62 dB
Toys helped stop a child crying.

Session 2:55 pm ~ 3:25 pm
Light Level: 310 Lux
Noise Level: 64 ~ 72 dB
Light level when I stood up and sat down were 480 vs. 230.

Children watched TV even when it was only showing advertisements.

Main Study

02/13/14

8:13 When a baby cry and make noise, other children started to get out of the seat or talk to parents. Maybe they feel insecure or need comfort from adults.
8:17 mom talk on the phone impatiently, 2yr old child got restless, tried a lot to get mom's attention.
8:19 lots of children's behaviors occur in Room A. Lots of children in Room B.
8:20 "play" was not included into the coding. But "Stop playing", which shows the focus/concentrate level of kids were.
8:21 a little desk was moved in the middle of the room, it reduced kids run.
8:24 children's behaviors may vary in the mornings and in the afternoons.
8:25 quiet, 4-yr old girl kept playing video games quietly and patiently. 12-yr old girl sits quietly and patiently.
8:28 I intended to avoid staring at patients or parents. My observation relied to other senses such as hearing rather than visions.
8:30 12-yr old whispered to mom for a little bit, not recorded as "get impatient and talk to parents".
8:34 3yr old fussed a lot. He coughed a couple fo times and breathed heavily. He appeared suffering badly. But when his mom paid lots of attention and plyed with him. He laughed.
8:46 mom's polite to staff, but impatient to the kid. The kid seemed impatient, too.
8:48 2-yr old talked to the baby sister.
8:50 calm mom and two happy kids. 2-yr old breathed heavily but appeared to be happy.
8:54 when other people talk loudly or other kids cry and make noises, it took other kids a minute to start getting restless.
9:01 kids make funny sounds, talk to parents.
9:03 baby cry a little bit.
9:04 baby cry, all kids talk to parents.
9:11 kids got impatient after waiting over 10 minutes.
9:17 kids acted restless and impatient but still showed happy behaviors.
9:19 4-yr old girl got restless in the seat and looked out of the window.
9:20 each kid has so different behavior patterns, and speaks to him/herself a lot, other run a lot, one cries a lot.
9:22 4-yr old got impatient a little bit, tried to talk to mom, got more and more impatient when mom didn't pay any attention.
9:24 some children started wiggling their legs when they got impatient.
9:39 kids seem happy. Do video games make children happy, too?
9:42 12-yr old girl giggled, recorded as laugh.
9:56 4-yr old boy came out from the doctor's office crying, but stopped soon after.
9:56 5-yr old boy showed up, walked into the toy corner directly.

9:59 5-yr old boy calmly asked his mom what she was doing. He got impatient when his mom didn't respond.
10:13 5-yr old boy stopped watching. He started staring at the 3-yr old girl.
10:17 7-yr old girl was happy. 3-yr old girl was calmly drawing, 5-yr old boy looked a little bored.
10:18 the kids were energetic at first but then got tired after running around.
10:28 3-yr old girl ran while crying. Not included into "run happily".
10:38 3-yr old girl drawing but made a lot of noise. She was doodling but more like dabbing on the paper.
10:44 3-yr girl doodling and made noise again.
10:47 14-yr old girl went to restroom looking bored. Marked as "get out of seat".
10:48 5-yr old girl showed up. She went into the toy corner directly.
10:52 a kid had nothing to do, started reading the adult fashion magazine.
11:04 the room's quiet. 2 girls got bored and started behaving restless.
11:08 light level's not hight even it's a sunny day because of the shade of the structure.
11:16 a baby was crying. The noise level was 60-71.
11:17 5-yr girl sitting down, eating snack.
11:48 only two quiet girls waiting. One was standing next to her dad. The other was sitting quietly.
11:54 the little girl got a little restless in the chair. It takes time to scroll down to subject number bigger than 29. Will use 1 to 30 in the afternoons.
12:53 quiet, noise level: 55
1:08 kid got out of seat to play toyrs. Not recorded as "get out of seat"
1:15 boy playing video game again, but quietly.
1:19 no patients in the room.
1:32 getting a little tired.
1:37 3-yr old boy showed up, went directly to the play corner.
1:41 even knowing there was no toy, the 3-yr old boy wanted to go back into the toy corner. He went in to the toy corner, made a little noise, then came back out.
1:43 baby girl played with the blinds, looking out of the window. The reason could be studied in the future studies.
1:50 today the blinds are open. Can see trees outside.
1:55 there is no patients in the room.
2:05 7-yr old showed up with 7-yr old sibling, went near the toy corner, looked into the corner.
2:18 3-yr old boy showed up, went directly to toy corner. He then ran happily for a little while.
2:20 3-yr old boy went into the toy corner again, then came out soon.
2:21 3-yr old boy climbed up a chair, looked out of the window, ran into the toy corner again.
2:24 the boy seemed very active, ran around, climbed the chair, looked out of the window, lay down on the floor, got up and ran around again.
2:29 the boy ran around a lot. He giggled and laughed, his mom giggled a lot, too.
2:31 9-yr old boy went into the toy corner.

2:45 the room was very quiet. We all felt sleepy and tired.
2:52 3-yr old boy climbed the wall.
2:57 the boy laughed loudly, made loud funny sound.
2:58 There is no patients in the room anymore.
3:12 5-yr old boy knocked on the wall of the toy corner as if he was knocking on a door.
3:50 there were two children waiting for over twenty minutes now. The snacks kept them calm.
4:30 7-yr old boy came out from the doctor's office, went straight back to the toy corner. He climbed upon the wall, then jumped off the wall.

02/14/14
8:50 3-yr old boy explored the trash can.
8:58 happy 4-yr old girl looked out of the window.
9:01 two girls lay on the floor.
9:37 children are actively playing. They wouldn't stop until their grandma asked them to.
9:50 two girls got under the chair, made the chair seem like a play hourse.
9:53 4-yr old girl explored the fire alarm on the wall.
10:02 two girls sat on the floor. Then walked around.
10:30 4-yr old girl kept looking out of the window.
10:37 girls looked out of window
10:52 so far I've seen toddlers to 7-yr old
11:00 2-yr boy eating snacks quietly in the seat.
11:01 6-yr old boy climbed up the wall.
11:03 people're whispering. The noise reading is 55dB.
11:08 I hear kids shouting in the doctor's office.
11:09 Children are crying and shouting. The noise reading is 80 dB.
1:37 one toddler was reading books quietly. The other child is falling asleep.
2:01 The girl giggled a lot when her dad was playing with her.

APPENDIX C

NORMAL TEST GRAPHICS

Table A. C. 1.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Light Levels	226	170	26200	1865.97	4511.816	3.835	.162
Valid N (listwise)	226						

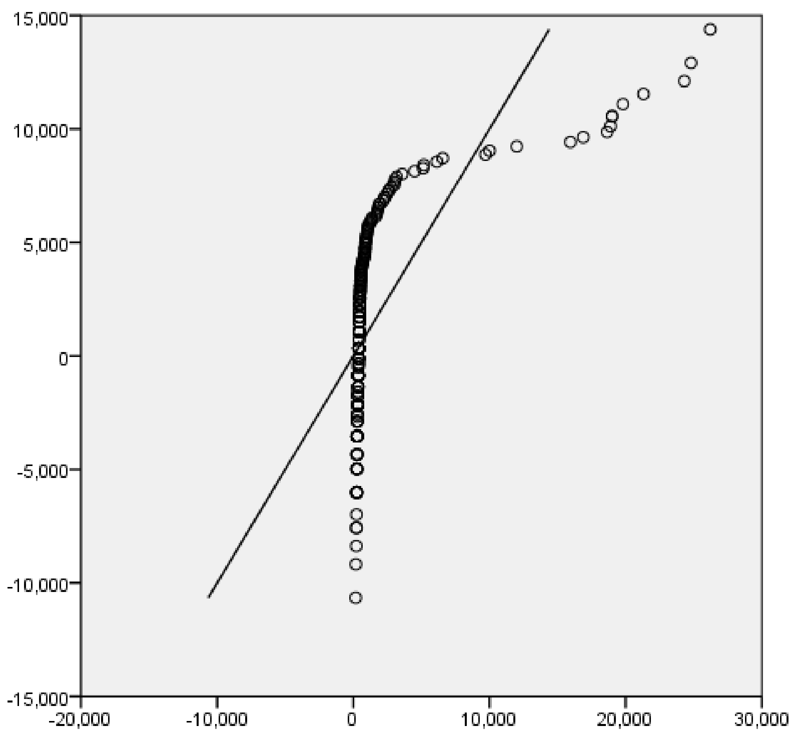


Figure A. C. 1. Q-Q plot of light levels in Room A and B

The data doesn't show normal curve. (See table A. C. 1.)

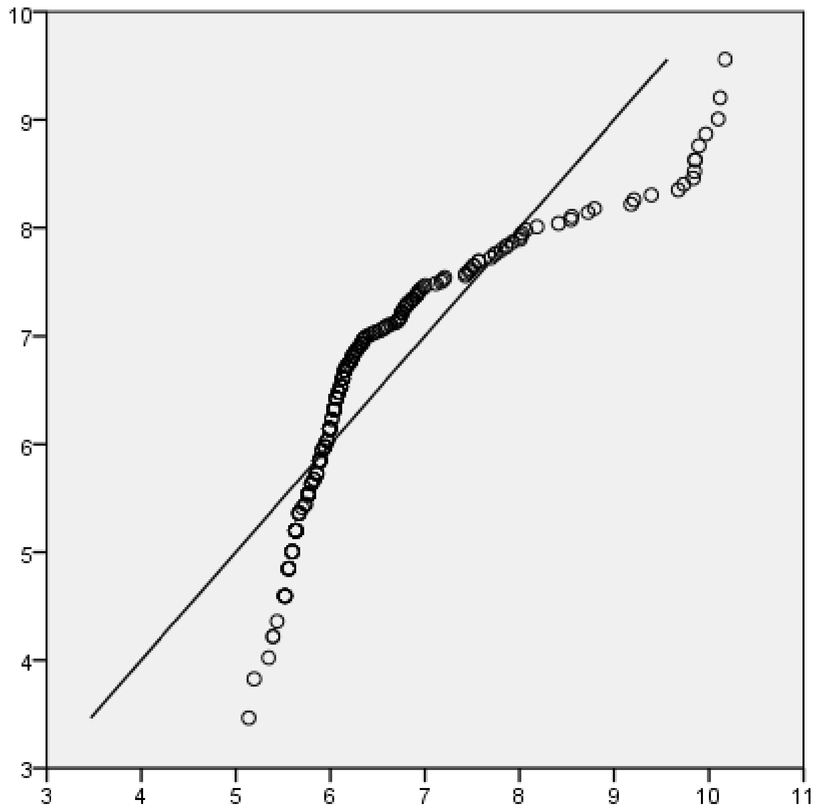


Figure Table A. C. 2. Q-Q plot of light levels in Room A and B (after log transform)

The data did not show normal curve after the log transform.

Table A. C. 2.

Light

N	Valid	143
	Missing	0
Mean		378.67
Std. Deviation		86.978
Skewness		.051
Std. Error of Skewness		.203
Minimum		180
Maximum		580

a. AorB = 0

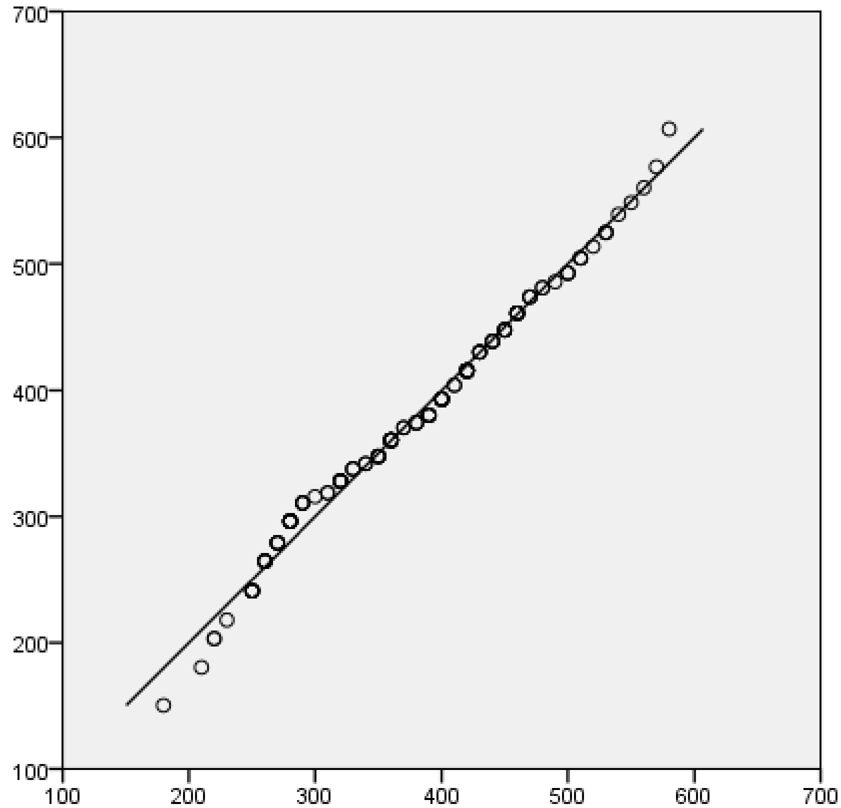


Figure A. C. 3. Q-Q plot of light levels in Room A

After separating the light measurements of Room A and Room B, clear normality showed of the light levels in Room A, M= 378.67, Std. = 86.978. The histogram showed the similar results. (See Table A. C. 3)

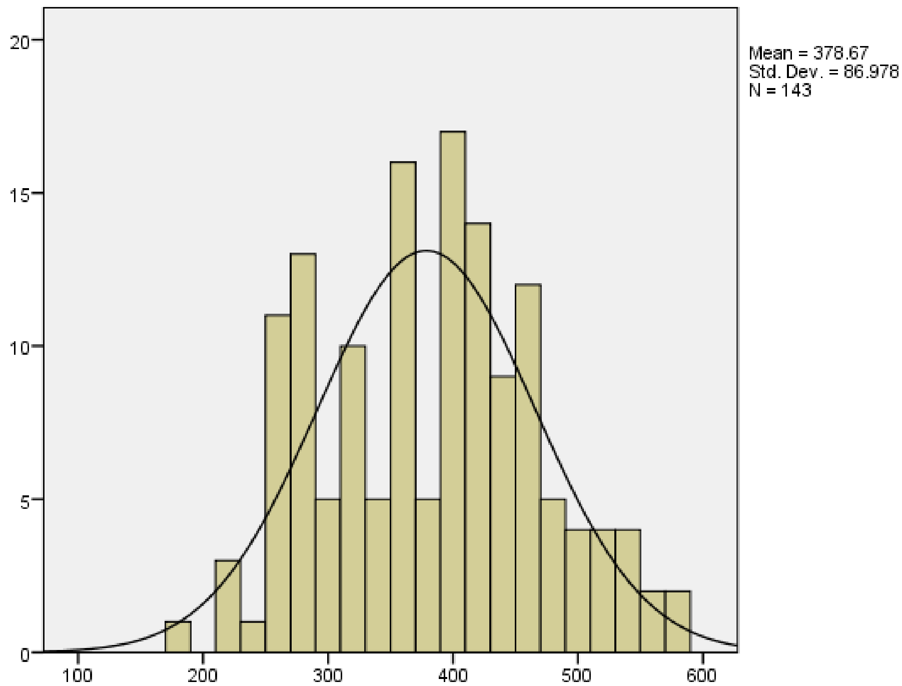


Figure A. C. 4. Histogram of light levels in Room A

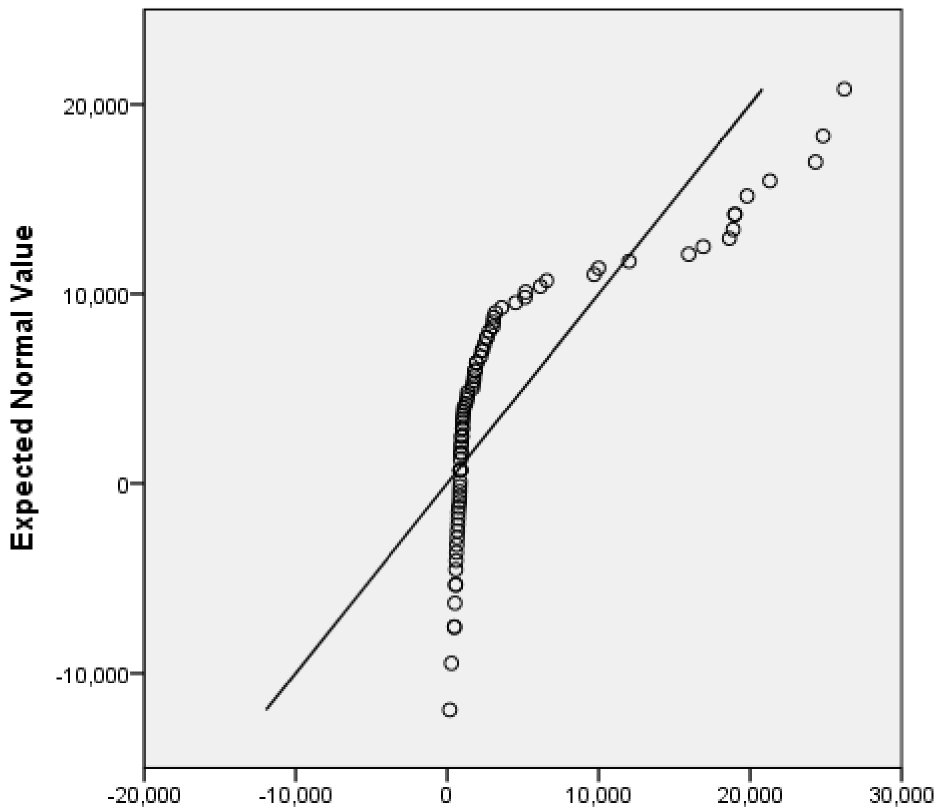


Figure A. C. 5. Q-Q plot of light levels in Room B

The light levels in Room B did not show normality. See Table A. C. 5

Table A. C. 3

Light

N	Valid	83
	Missing	0
Mean		4428.43
Std. Deviation		6733.438
Skewness		2.007
Std. Error of Skewness		.264
Minimum		170
Maximum		26200

a. AorB = 1

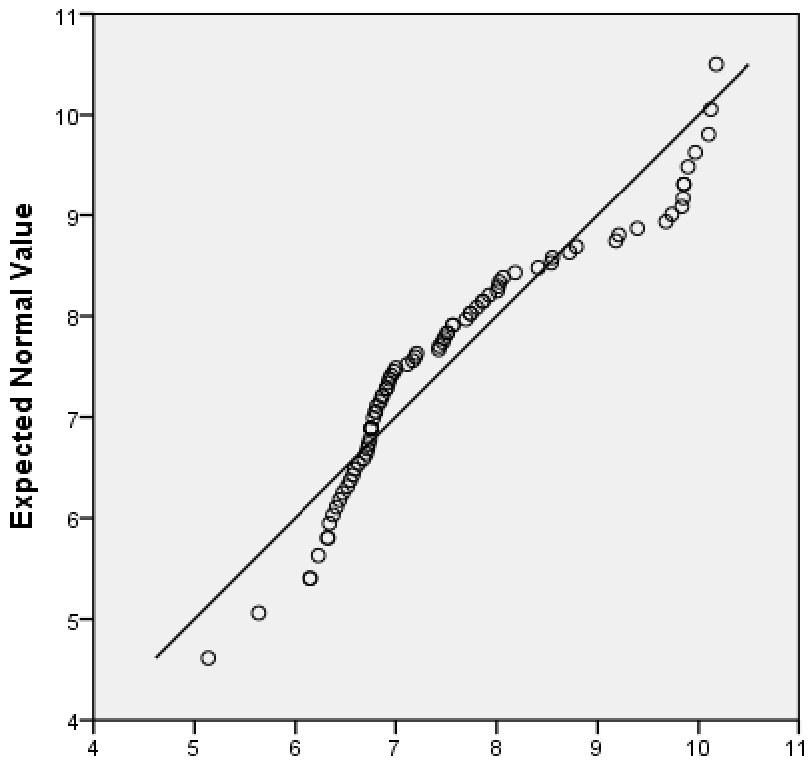


Figure A. C. 6 Q-Q plot of light levels in Room B (after log transform)

After the log transform, the data showed normal curve more.

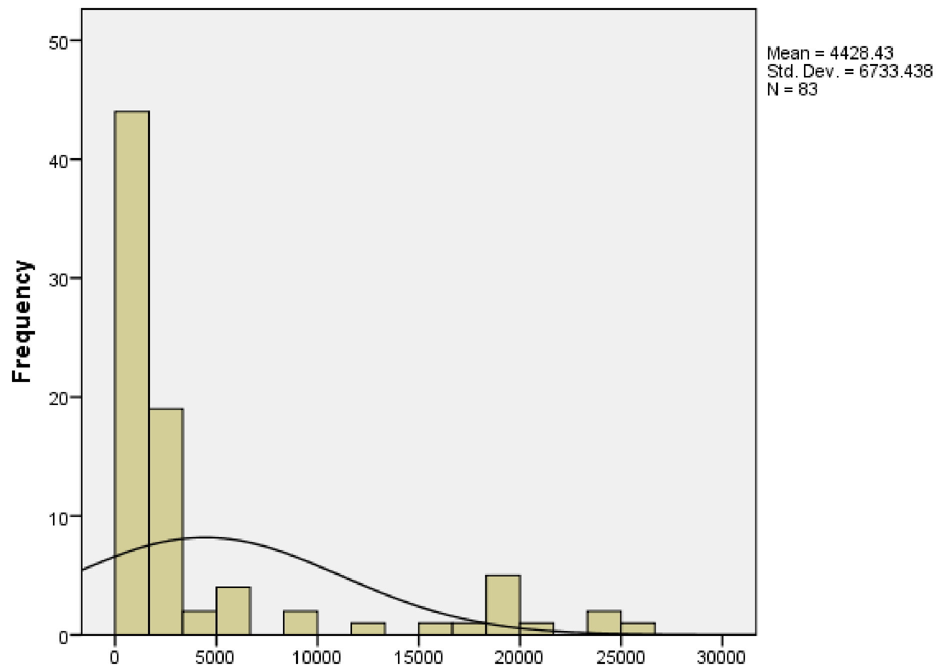


Figure A. C. 7. Q-Q plot of light levels in Room B

Light measurements in Room B didn’t show normality before or after the log transform. In the histogram we can see that the majority of the measurements fell between 0-5,000 lux, with a group of measurements fall between 5,000-20, 000 lux and a few cases of glare that were around 25, 000 lux

3.2.1.2 Normality tests for dependent variable

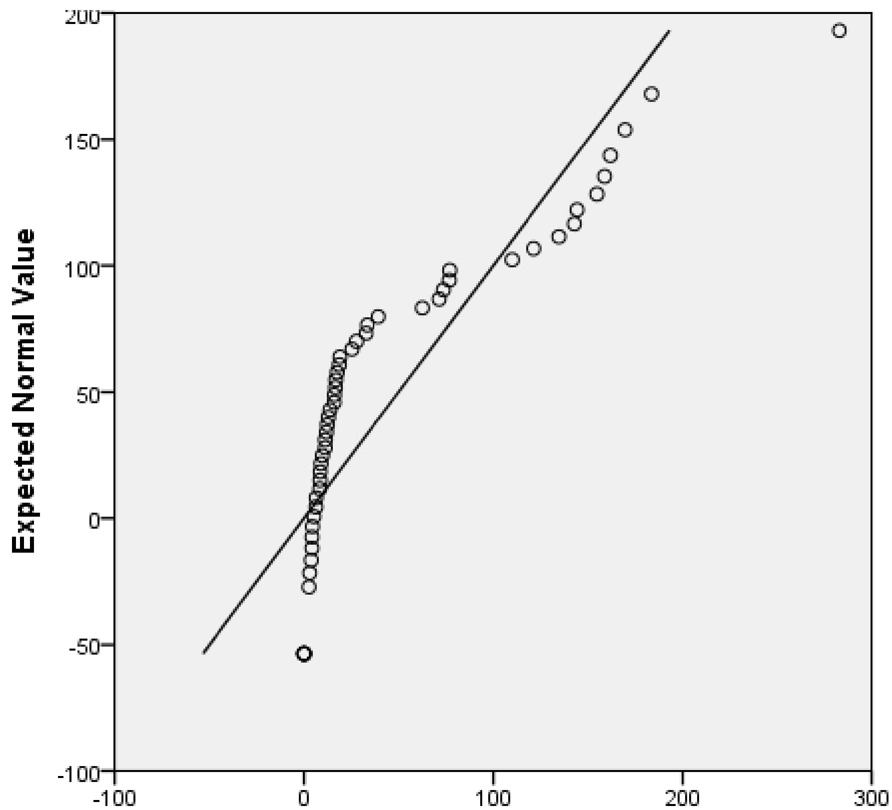


Figure Table A. C. 8   Q-Q plot of cry durations in Room A

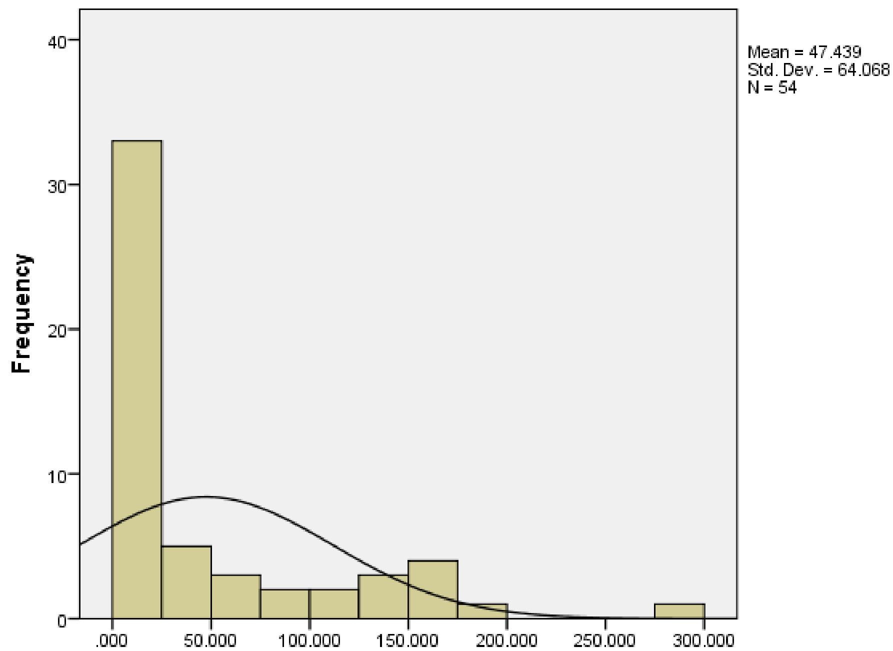


Figure A. C. 9 Histogram of cry durations in Room A

The cry duration didn't show normality. As shown in the histogram, the majority of the data was between 0-50 seconds. This means that of the most sessions that cry occurred, the average duration of crying were 0-50 seconds. There were 54 sessions that crying occurred.

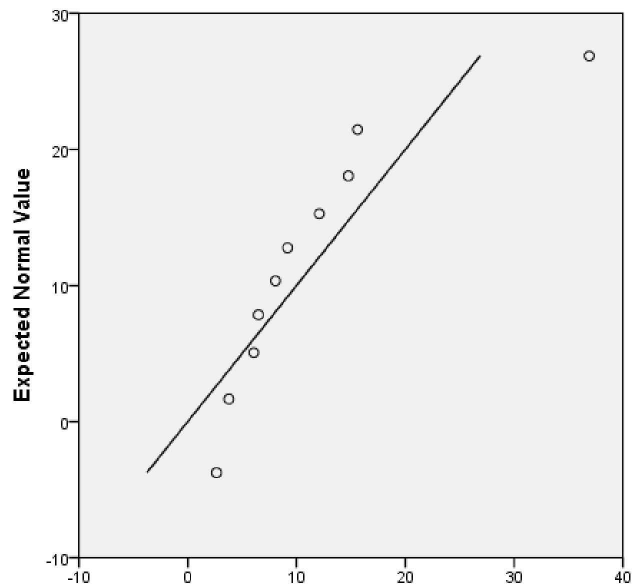


Figure A. C. 10 Q-Q plot of cry durations in Room B

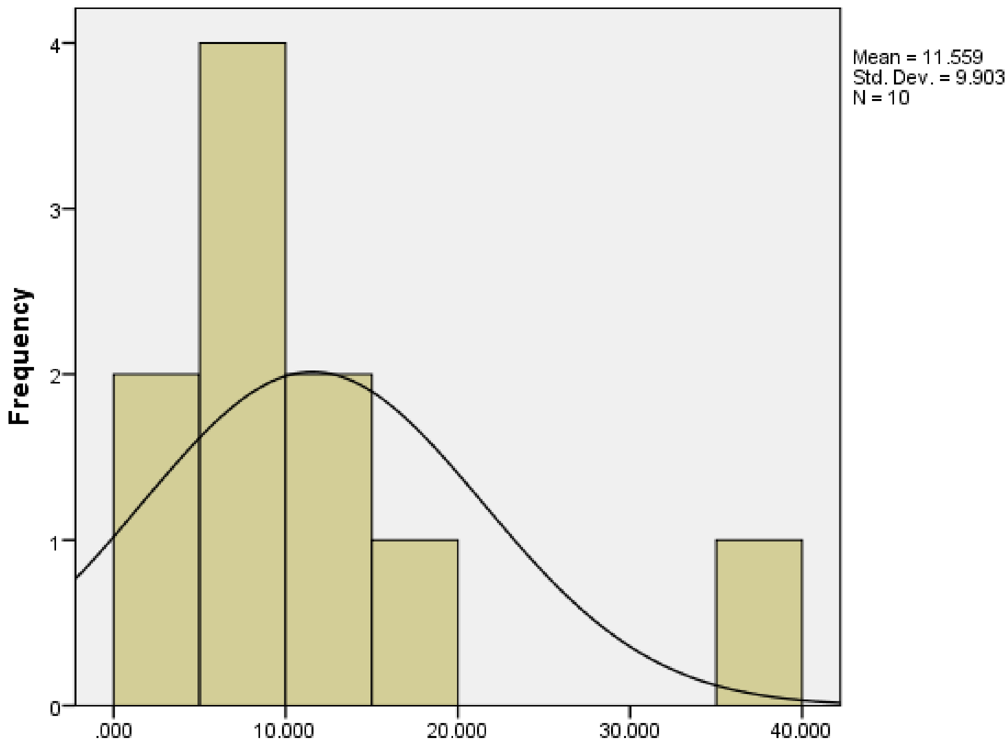


Table A. C. 11 Histogram of cry durations in Room B

The cry duration occurred in site B showed slightly normality. The data is skewed to the left of 10 seconds. The majority of the duration means was between 0-20 seconds. Cry occurred in 10 sessions.

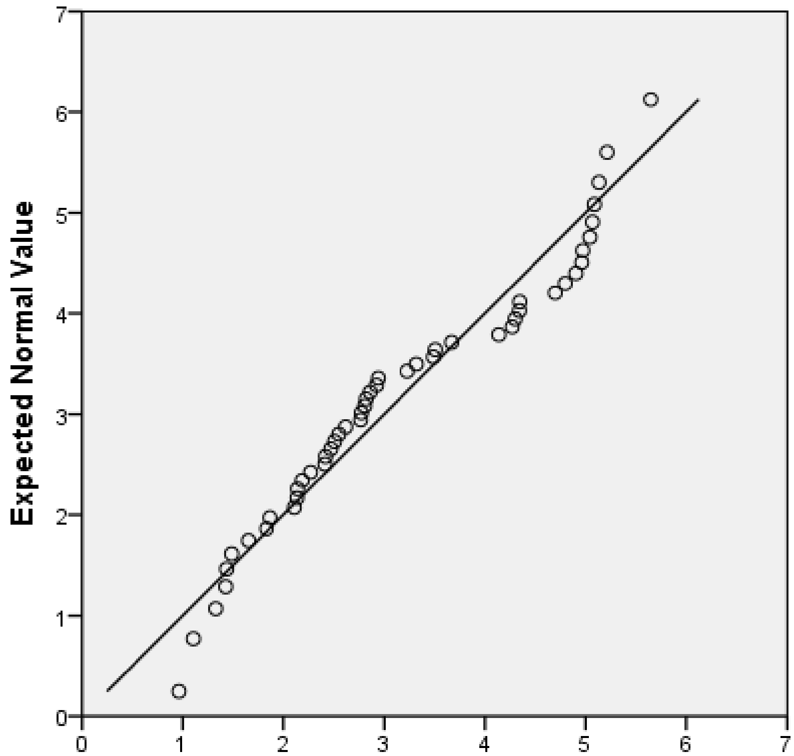


Figure A. C. 12 Q-Q plot of cry durations in Room A

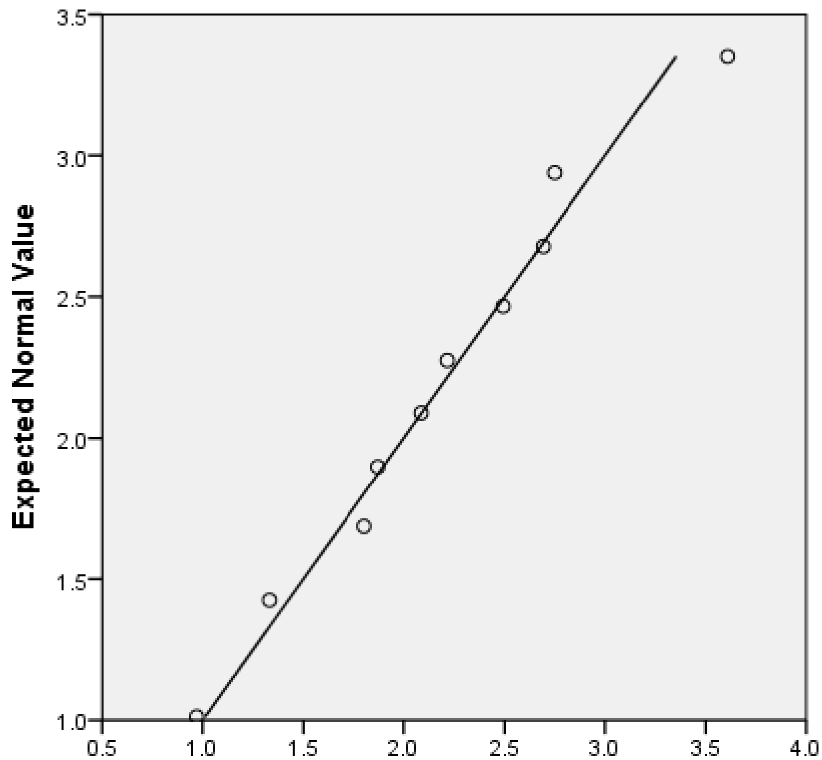


Figure Table A. C. 13 Q-Q plot of cry durations in Room B (after log transform)

After the log transform, the data showed tendency of normality in both sites.

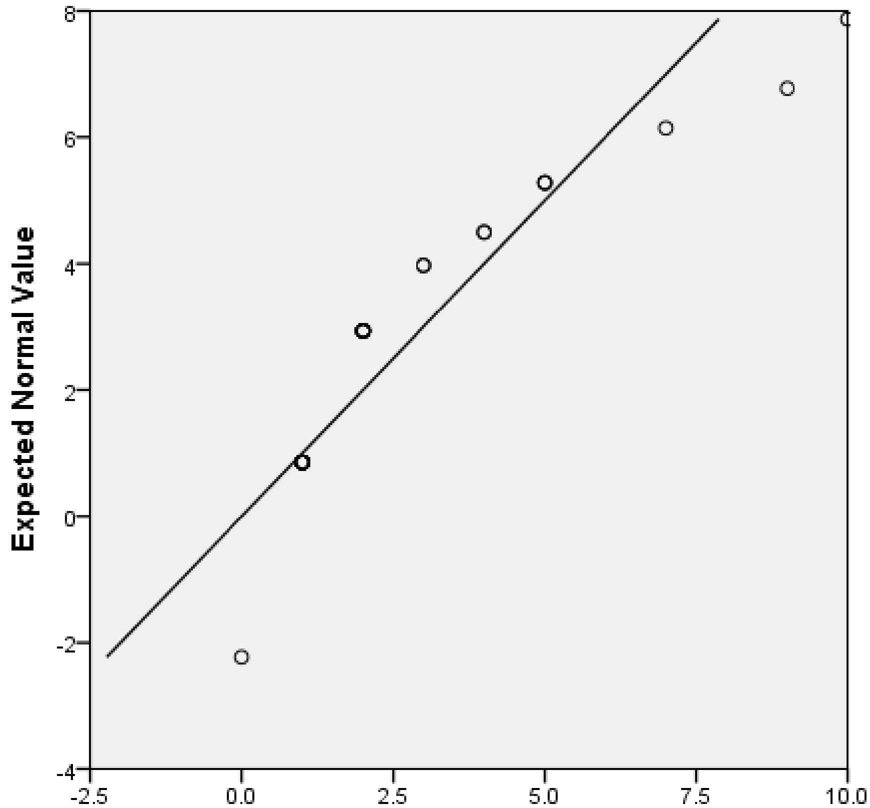


Figure A. C. 14 Q-Q plot of fighting in Room A

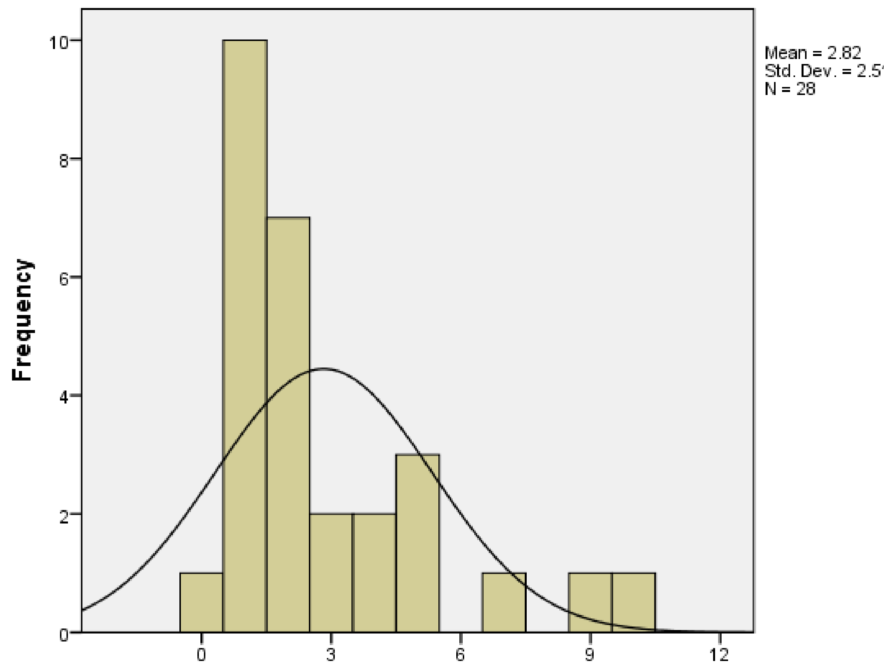


Figure A. C. 15 Histogram of fighting in Room A

From the Q-Q plot we can see that the occurrence of fighting showed a slight tendency toward normality in Room A. In the histogram we can see that the data is skewed to the left of 5. The majority of the data fell between 1- 3. This means that in most of the observation sessions fight happened 1-3 times.

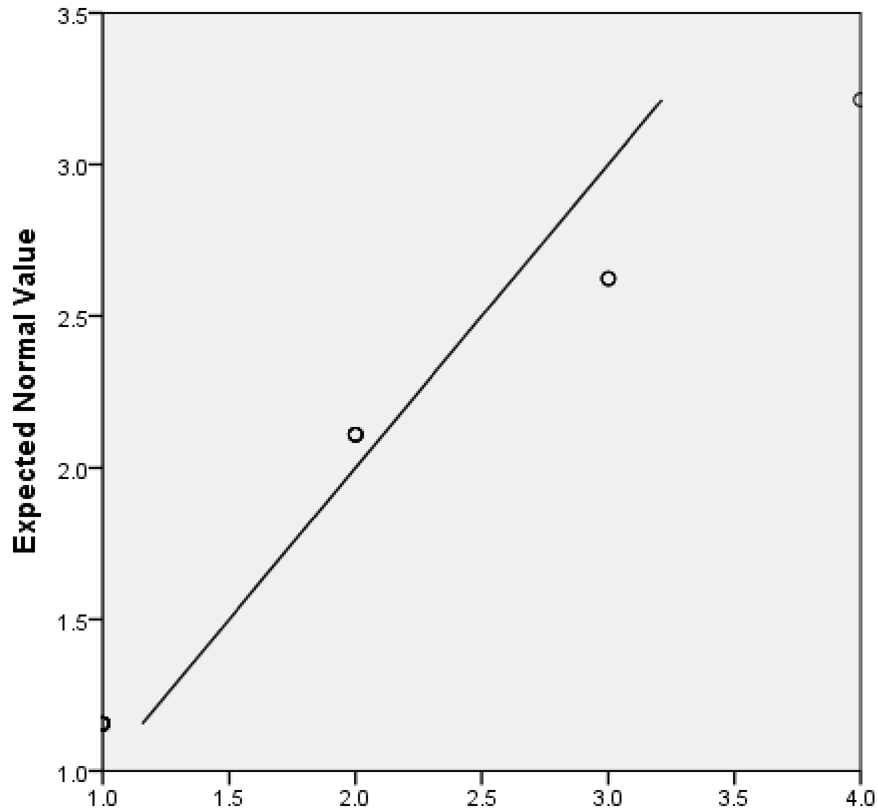


Figure A. C. 16 Q-Q plot of fighting in Room B

The occurrence of fight didn’t show normality in neither site

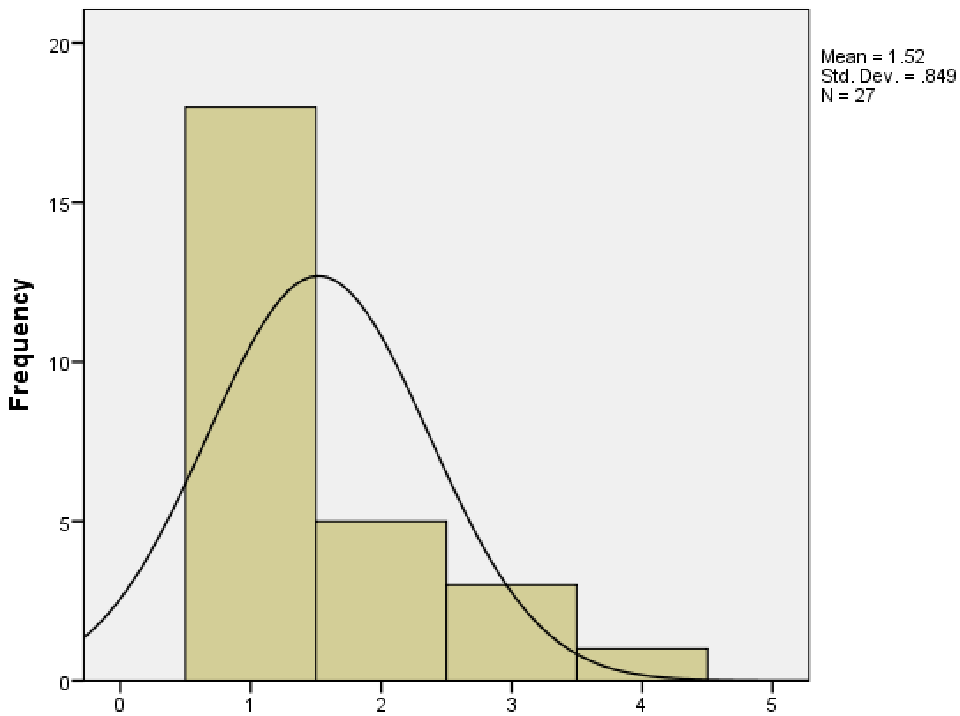


Figure A. C. 17 Histogram of fighting in Room B

The occurrence in Room B didn't show normality either. In the histogram we can see that the majority data fell between 1- 2. This means that of the sessions that fight occurred, the average of fighting occurrence was one to two times. And the total occurrence throughout the whole observation was 27.

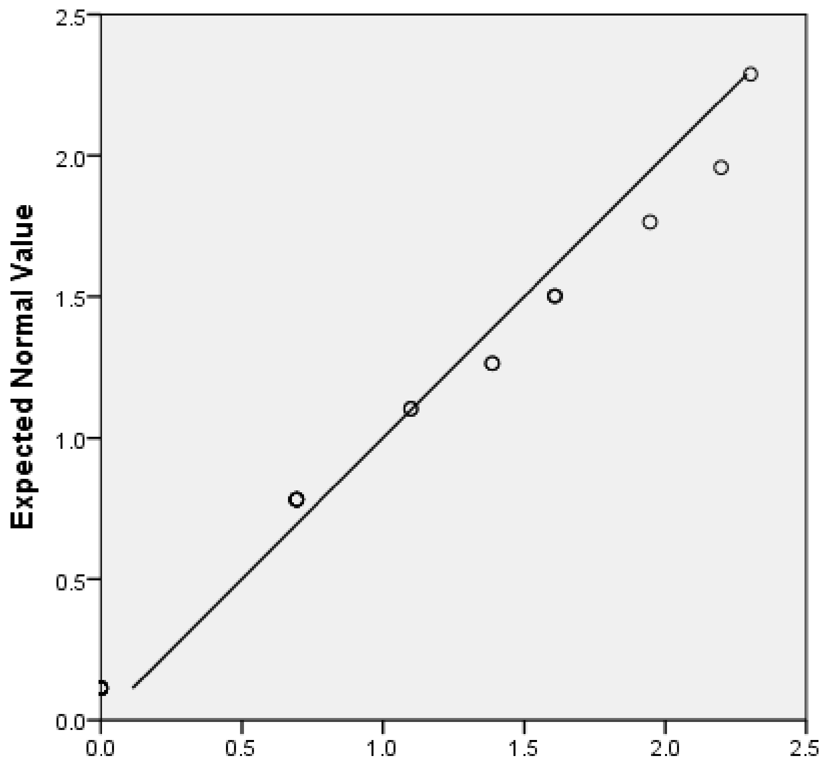


Figure A. C. 18 Q-Q plot of fighting in Room A (after log transform)

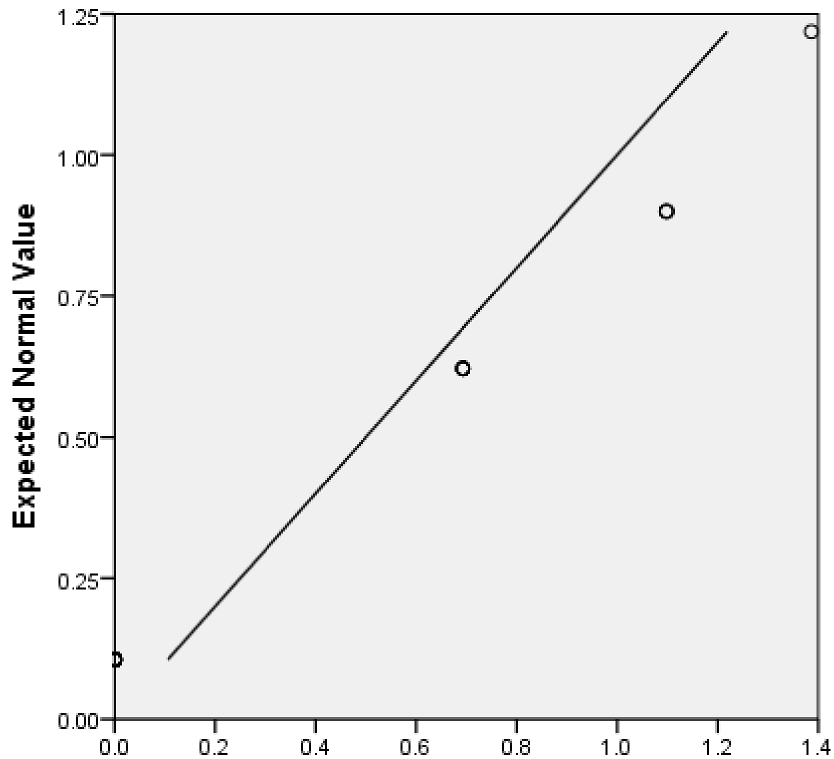


Figure A. C. 19 Q-Q plot of fighting in Room B (after log transform)
The data still didn't show normality after the log transform.

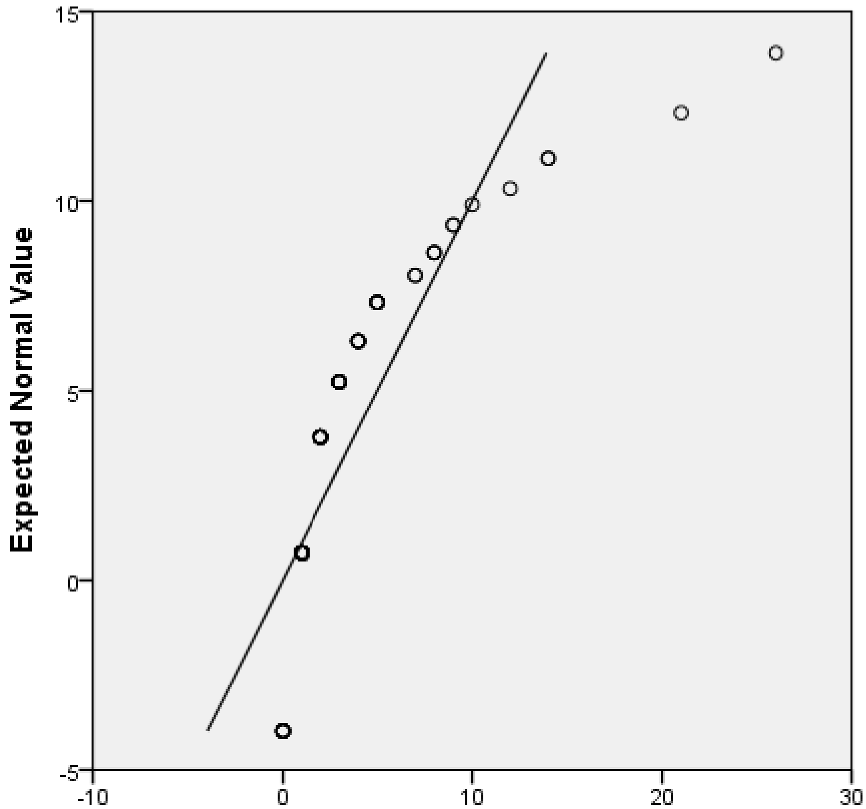


Figure A. C. 20 Q-Q plot of getting impatient and starting to talk to parents in Room A

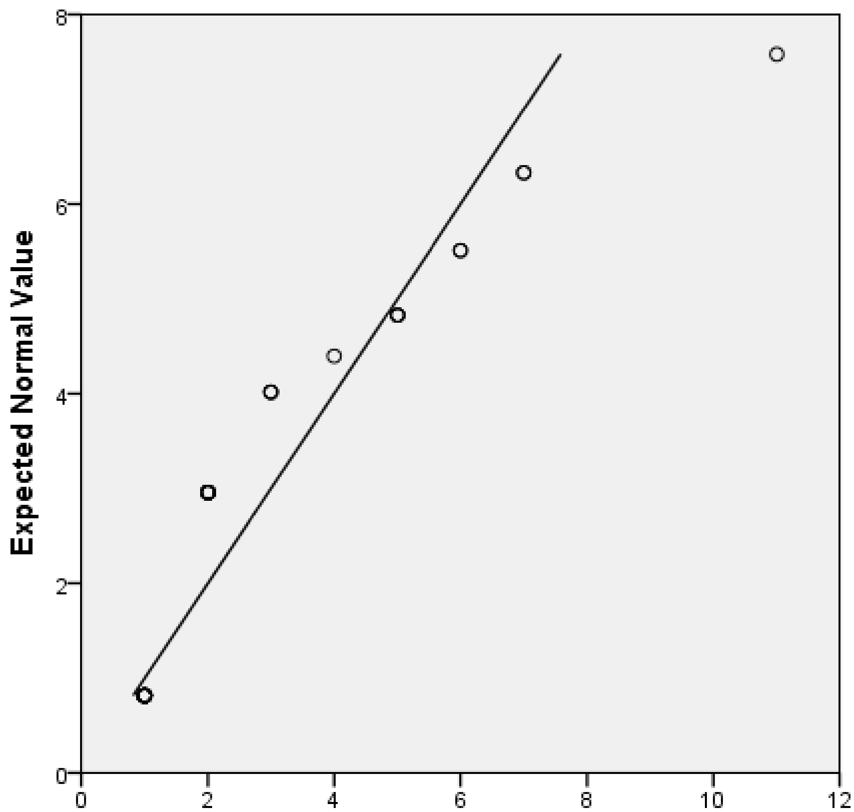


Figure A. C. 21 Q-Q plot of getting impatient and starting to talk to parents in Room B

The means of getting impatient and starting to talk to parents didn’t show normality

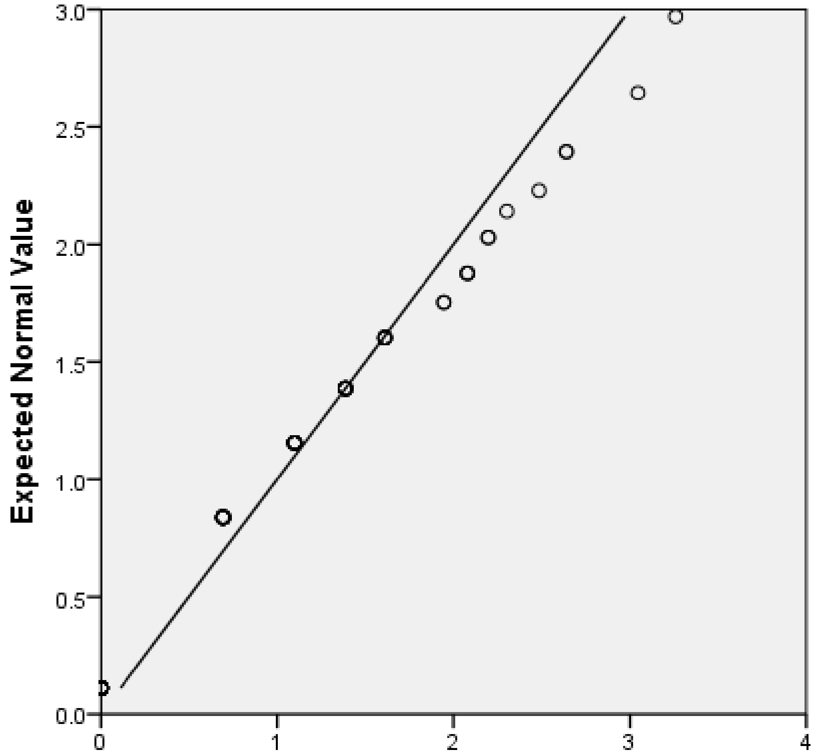


Figure A. C. 22 Q-Q plot of getting impatient and starting to talk to parents in Room A

(after log transform)

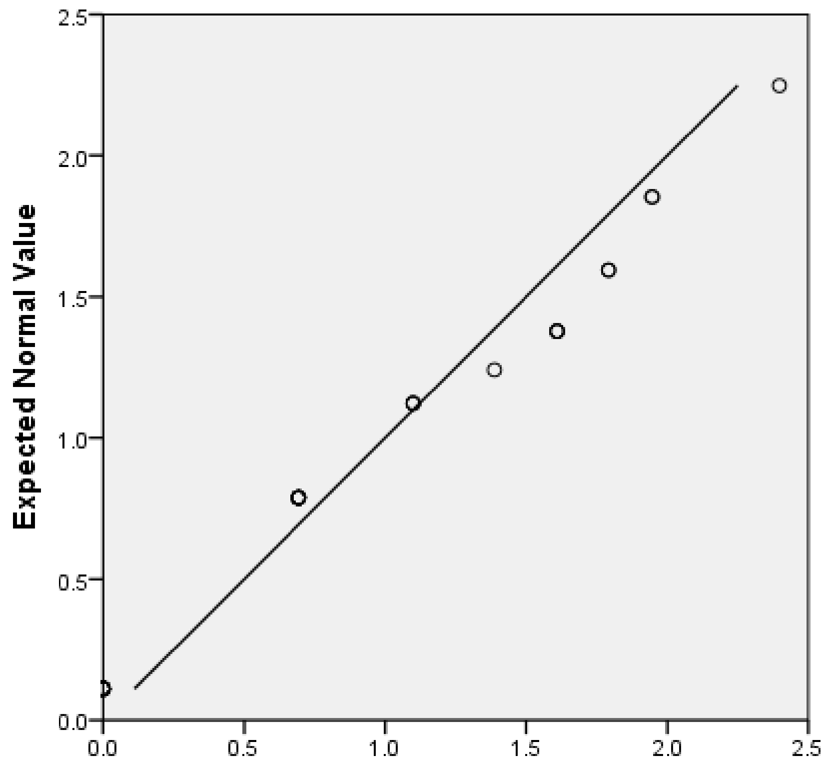


Figure A. C. 23 Q-Q plot of getting impatient and starting to talk to parents in Room B (after log transform)

The data did not show normality after the log transform.

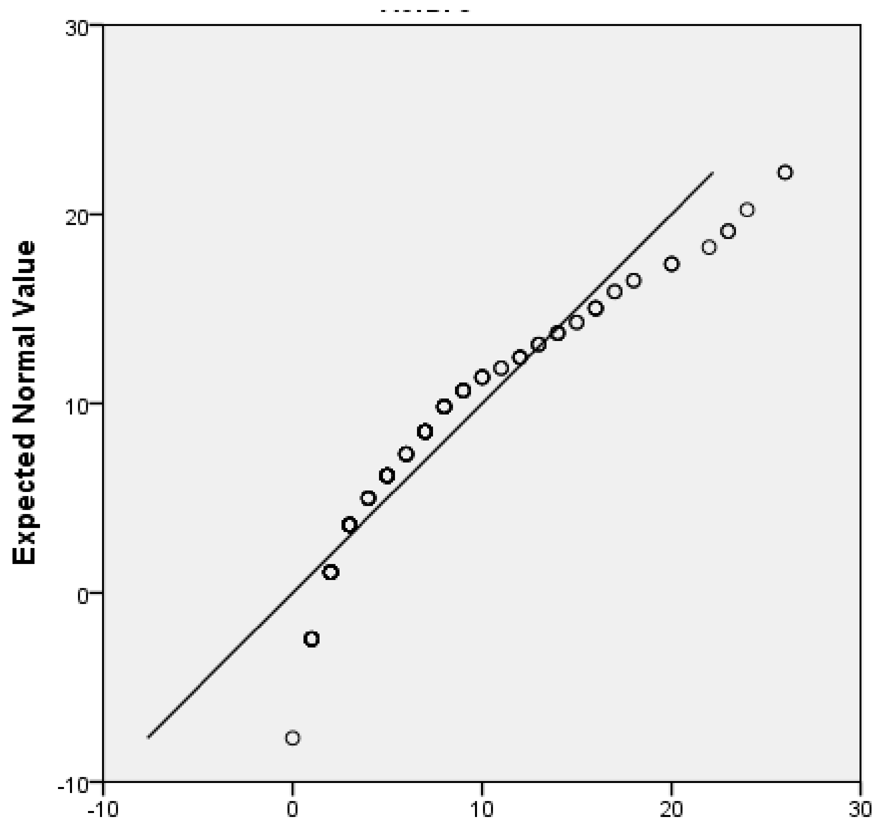


Figure A. C. 24 Q-Q plot of getting out of the seats in Room A

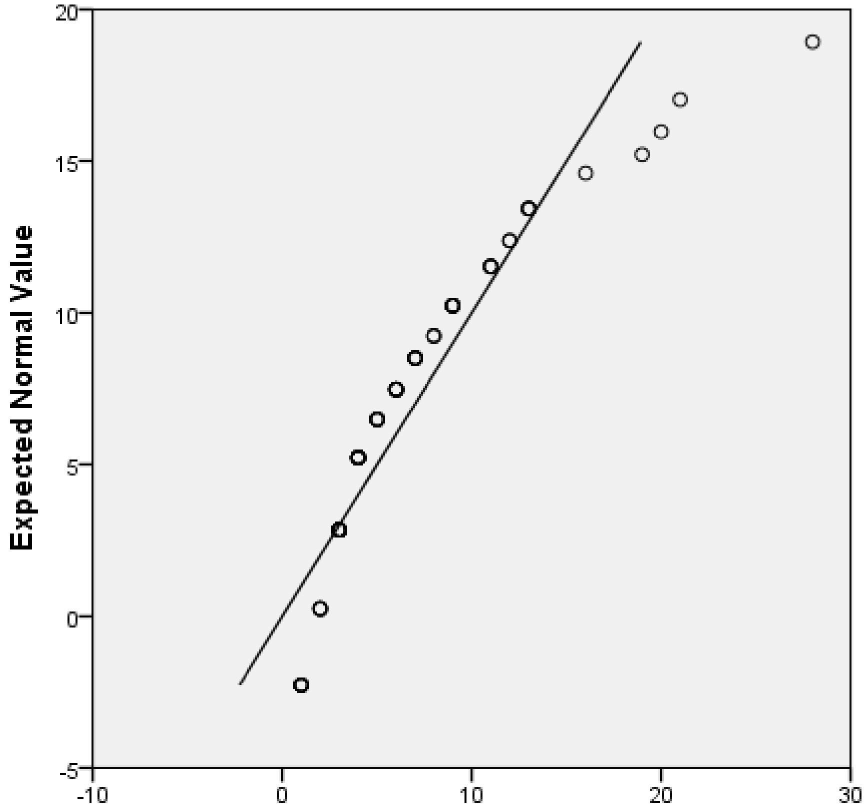


Figure A. C. 25 Q-Q plot of getting out of the seats in Room B

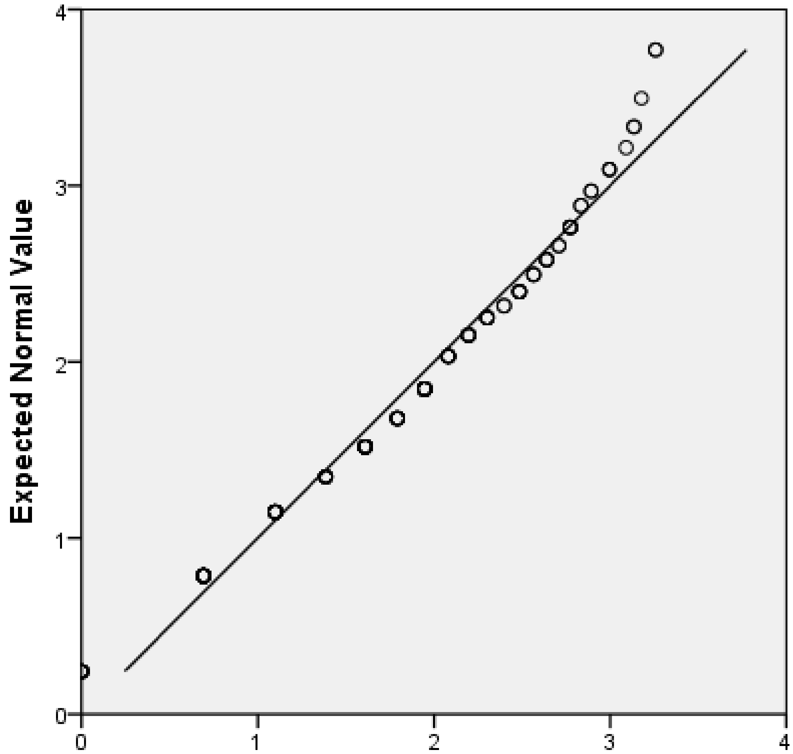


Figure A. C. 26 Q-Q plot of getting out of the seats in Room A (after log transform)

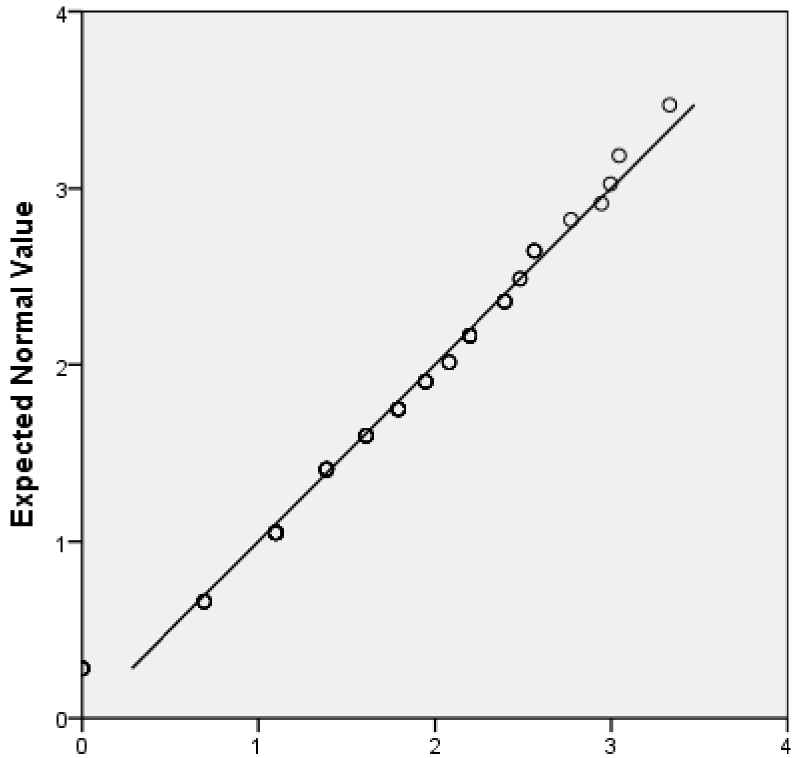


Figure A. C. 27 Q-Q plot of getting out of the seats in Room B (after log transform)

The occurrence of the children getting out of their seats did not show normality.

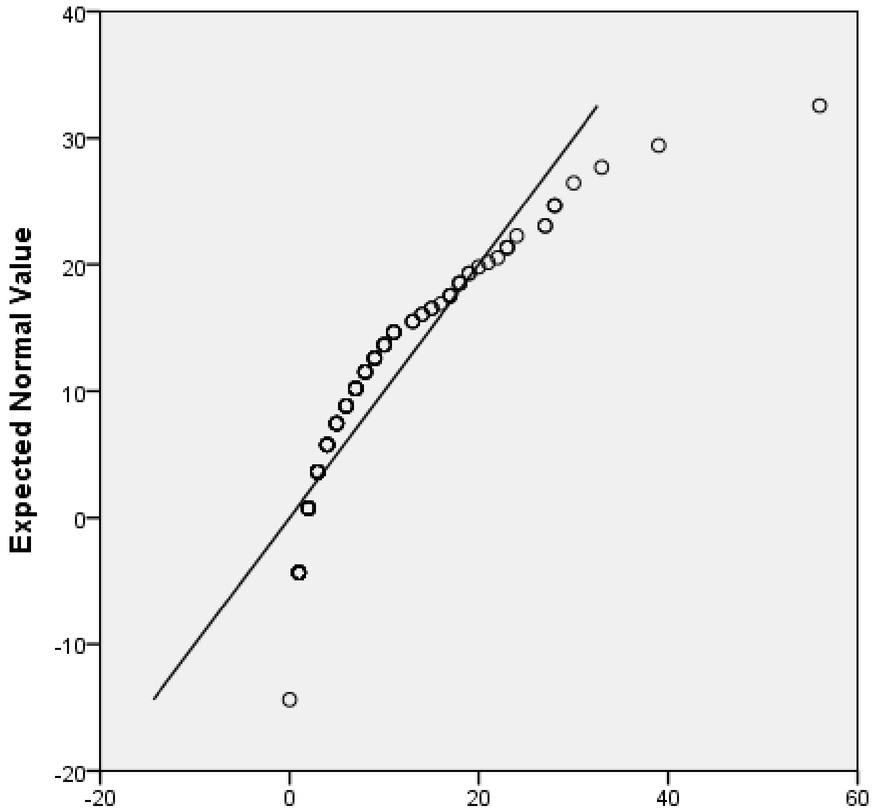


Figure A. C. 28 Q-Q plot of getting restless in the seats in Room A

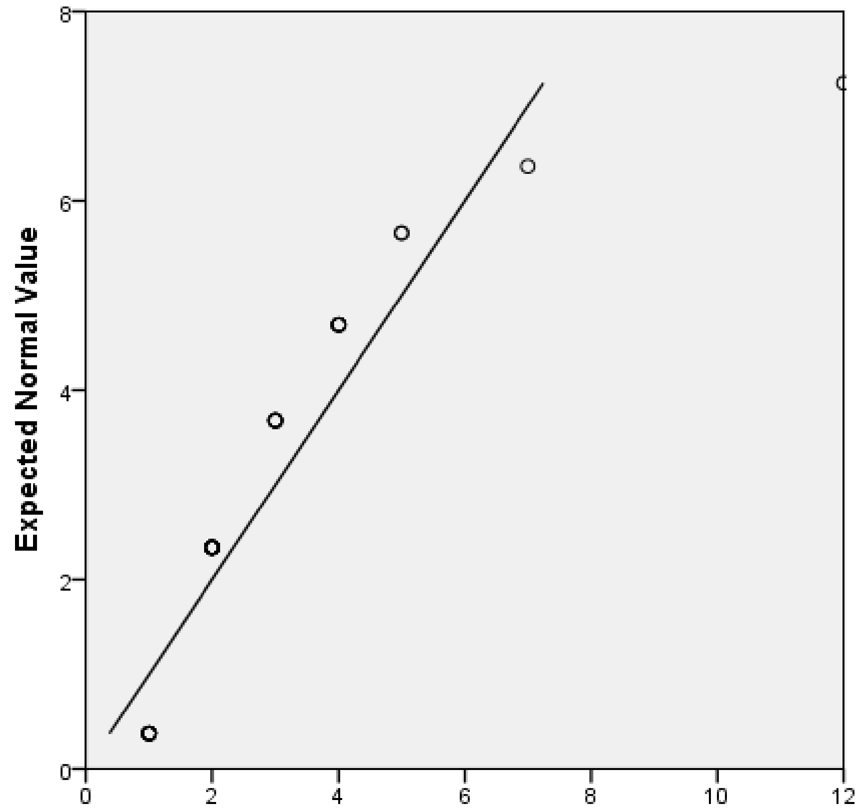


Figure A. C. 29 Q-Q plot of getting restless in the seats in Room B

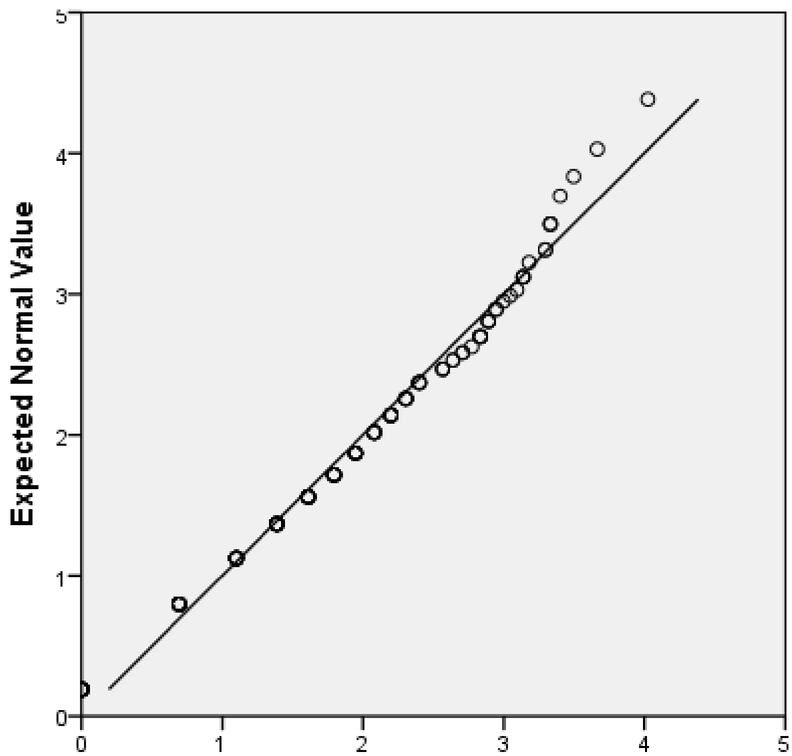


Figure A. C. 30 Q-Q plot of getting restless in the seats in Room A (after log transform)

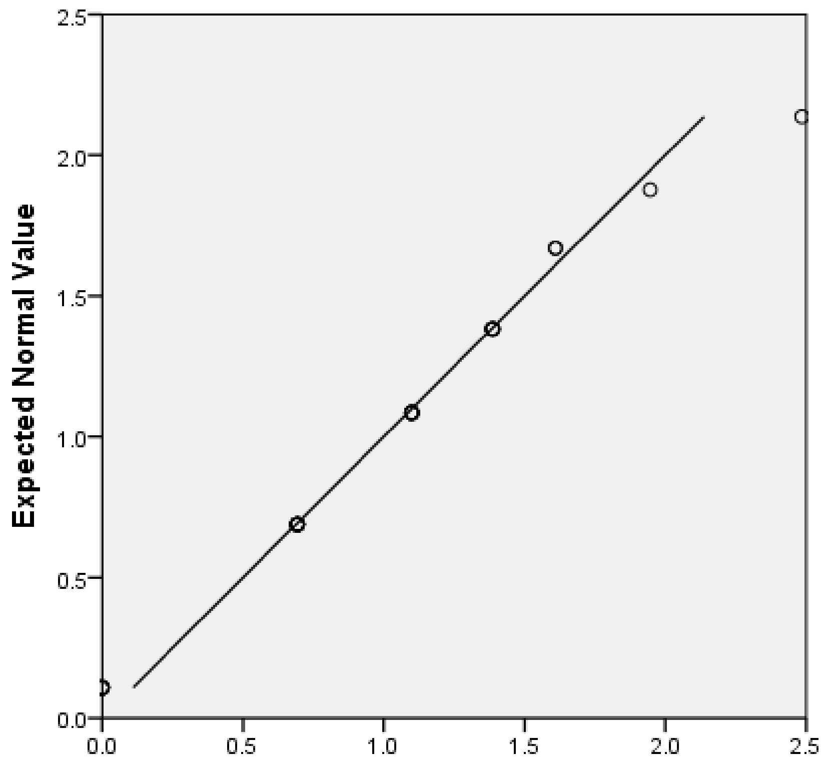


Figure A. C. 31 Q-Q plot of getting restless in the seats in Room B (after log transform)

The occurrence of getting restless in the seats did not show normality. Same with shouting, sing duration, laughing, running, speaking to oneself and making cute sounds.

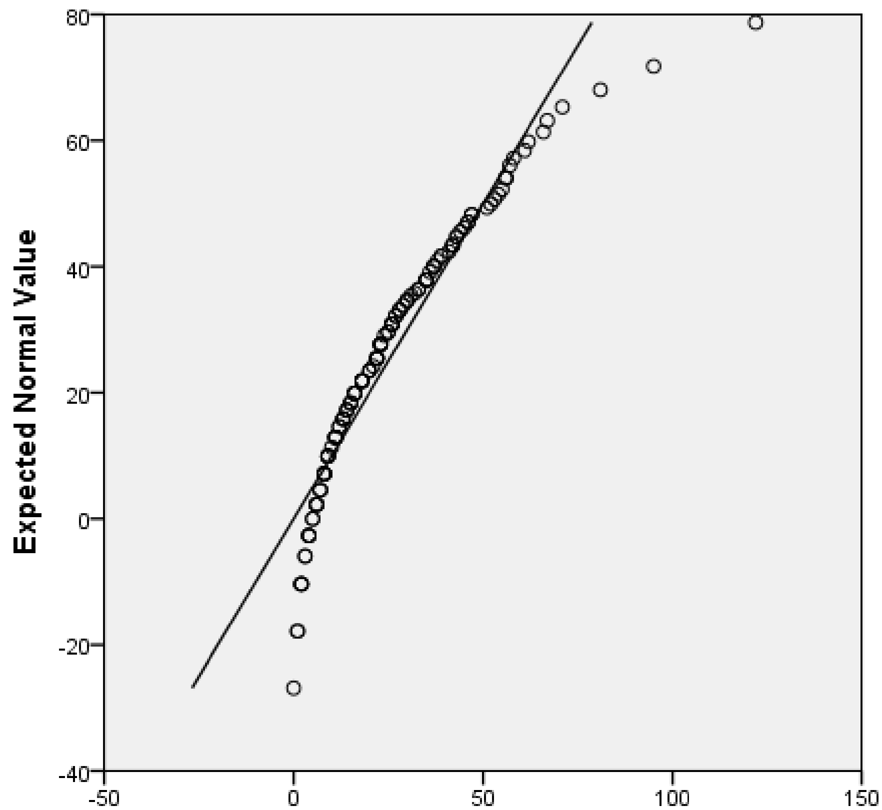


Figure A. C. 32 Q-Q plot of the total negative behaviors in Room A

The total number of negative behaviors in Room A did not show normality.

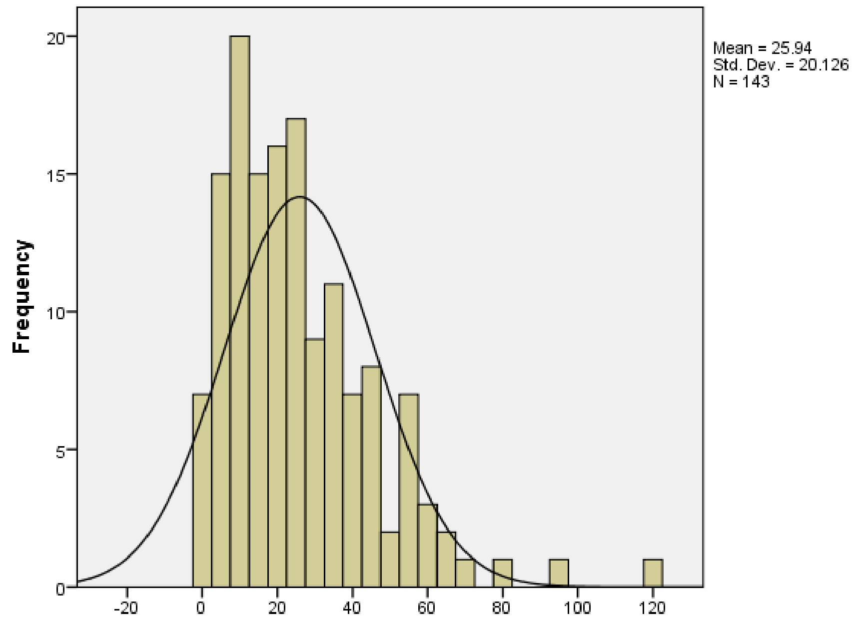


Figure A. C. 33 Histogram of the total negative behaviors in Room A

The total occurrence of negative behaviors in Room A showed slight normality, the data is slightly skewed to the left of 20. The majority results fell between 0-40.

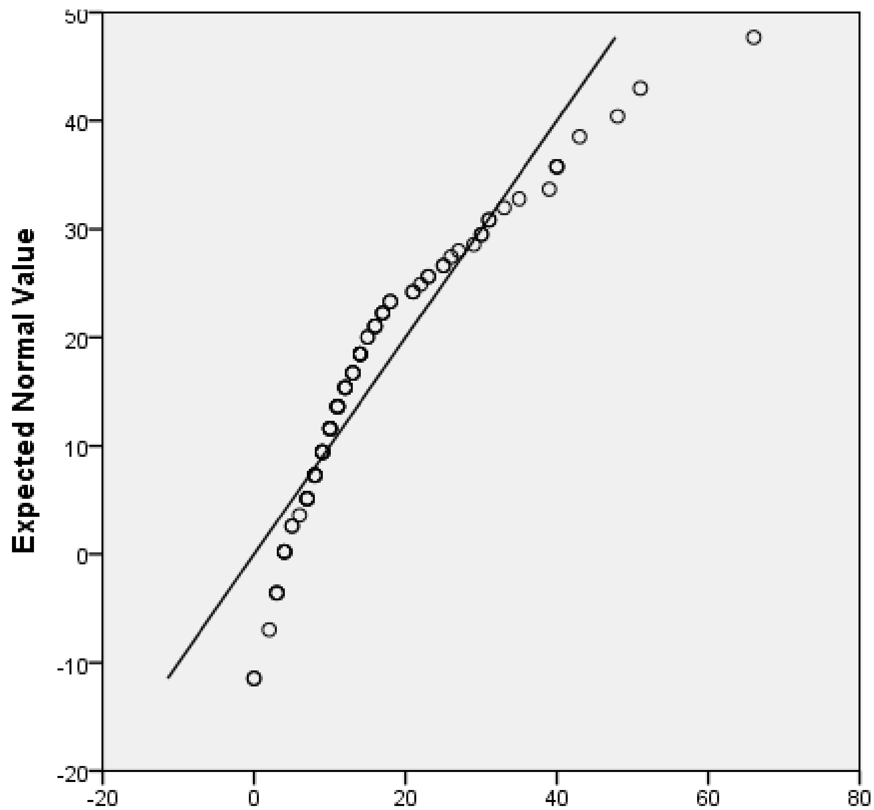


Figure A. C. 34 Q-Q plot of the total negative behaviors in Room B

The total number of negative behaviors in Room B did not show normality.

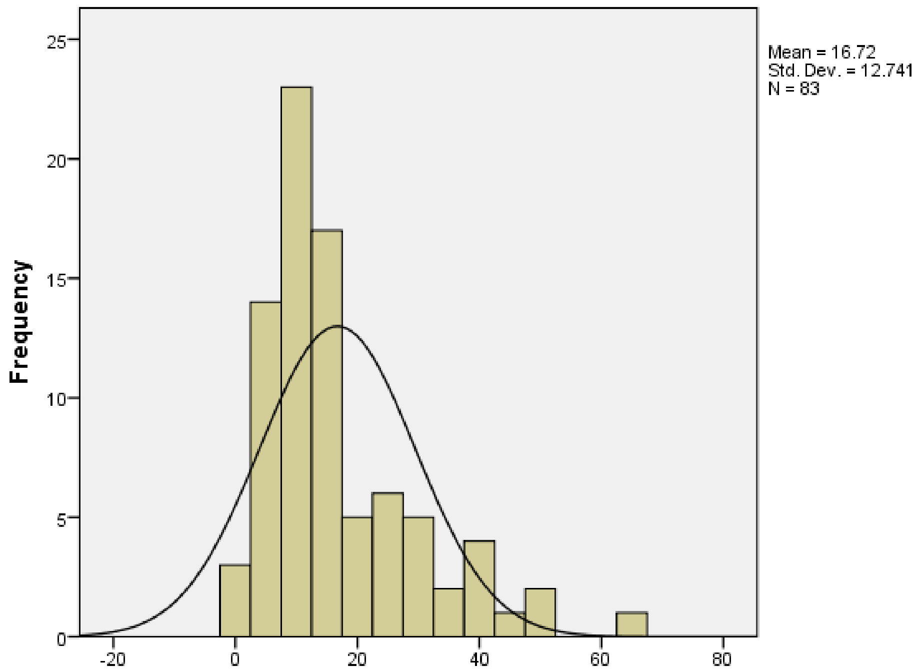


Figure A. C. 35 Histogram of the total negative behaviors in Room B

The total occurrence of negative behaviors in Room B showed slightly normality. The data is slightly skewed to the left of 15-16. The majority results fell between 0-25