THE ATTRACTIVENESS OF UNIVERSAL DESIGN IN PUBLIC PLAY ENVIRONMENTS FOR PEOPLE OF ALL ABILITIES

A Dissertation

by

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ABSTRACT

Accessible play environments have received considerable attention in recent practice; opinions vary from seeing them as critical links for serving a disadvantaged population, to a more negative viewpoint of their reducing overall challenge and fun. Little comparative research has been done to evaluate the use of specific playground features as indicators of attractiveness. The primary aim of this dissertation research is to test the hypothesis that play environments designed to the higher accessibility standard of Universal Design (UD) are used more frequently by people of all abilities than those designed meeting only Accessible Design (AD) ADA minimums. The secondary aims is to fill knowledge gaps in the literature by evaluating the impacts that specific physical elements of the play environment have on use, as well as their links to physical activity.

This dissertation research is a cross-section case study that applies established protocols of momentary environmental observation at the playgrounds of three public parks within one city where physical qualities and demographics are similar throughout, and many potential confounding variables are controlled. The study compares playgrounds in one case employing UD, and two comparisons employing AD. Observations were made on 14 days in each park during 5 time periods, producing 210 observations, 70 in each park. Recording was done graphically on maps of each park and playground identifying a user's approximate age, gender, and physical activity level.

Data analysis was accomplished using descriptive statistics and ANOVA to test the primary hypothesis. Zero-inflated Negative Binomial Regression was also performed on 10 environmental variables of physical park and playground elements to evaluate potentially confounding relationships for significance. Exploratory qualitative analysis was used for the

secondary aims, evaluating where users were in the park and their relationships with specific physical park elements categorized by behavior settings.

Findings showed more than 50% greater use in the UD playgrounds compared to the AD playgrounds. The indication of greater attractiveness supported by greater use of UD playground facilities can serve to underwrite policies promoting the more costly UD practices not only for the benefit of those with disabilities but also for the overall public benefit resulting from greater levels of outdoor physical activity for people of all ages and abilities.

DEDICATION

To my parents, Kenneth and Marlys Hurst, and my wife, Cheryl.

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NOMENCLATURE

AD	Accessible Design
ADA	Americans with Disabilities Act
ADAAG	ADA Accessibility Guidelines
ANOVA	One-way Analysis of Variance
CNR	Child/NonChild Ratio
MET	Metabolic Equivalent
NBREG	Negative Binomial Regression
PA	Physical Activity
PRM	Poisson Regression Model
s.f.	square feet
SOPARC	System for Observing Play and Recreation in Communities
TA	Target Area
UD	Universal Design
ZINB	Zero-Inflated Negative Binomial Regression

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1. INTRODUCTION

The primary aim of this research is to examine whether public play environments designed meeting Universal Design (UD) principles may be more attractive to the general public than are those designed to simply meet statutory Accessible Design (AD) minimums. The secondary aims are to evaluate potential relationships between use and the physical elements that make up a park or playground environment and their contribution to physical activity levels. The contribution of the research is to evaluate the impact of a specific physical element, UD in playground environments with respect to the benefit of the overall public while also providing benefit to those having disabilities. The research also seeks to identify positive contributions park and playground amenities make to outdoor physical activity as a whole.

The definition of AD in playgrounds that is used in this dissertation is those meeting the minimum Federal standards as specified in the 2010 ADA Standards for Accessible Design. The definition of UD is based on the general definition of universal design from North Carolina State University "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaption or specialized design" (Story, 2011). It applies the intent of this widely accepted definition in more quantifiable terms based on the 2010 ADA Standards with respect to playgrounds and going beyond them, the specifics of which will be detailed later in this document.

1.1 Purpose

Play environments in public parks are critical settings for getting children and their families outdoors, active, and interacting with each other (Prellwitz & Skar, 2007). A case study was done in Cary, North Carolina that identified the value of inclusion and going beyond those

minimums applying UD principles in children's play environments (Moore & Cosco, 2007). In the spring of 2012, an informal pilot study observing public park users found three times the adjusted use at a playground designed using UD principles versus those designed only meeting AD standards (Hurst & Lee, 2014).

There is a movement in the design disciplines to go beyond the minimum AD standards used in play environments by applying UD principles making play places usable by people of all abilities without the need for adaption (Goltsman, 2011; Moore & Cosco, 2007), getting children outdoors and active, turning the tide of the obesity epidemic (Kerr, 2007). While there is a considerable body of research on inclusion and building inclusive play environments (Burke, 2012; Jeanes & Magee, 2012; Prellwitz & Skar, 2007; Moore & Cosco, 2007), there is very little published work on the value these inclusive environments contribute to the general public.

A growing body of evidence illustrates the contribution outdoor open space and public parks provide in facilitating increased levels of physical activity. The goal is improving health and reducing obesity in society with the accompanying benefit of reducing the cost of public healthcare (Mowen, 2010). Much of the research in the outdoor public setting is done on the large scale with a shortage of research investigating the contribution of specific attributes of the park environment to evaluate associations between amenities, and use, and physical activity (Colabianchi, et al., 2011; Kaczynski & Henderson, 2008).

1.2 Structure of the Dissertation

Physical elements in the environment are the central focus of this dissertation as a result of the author's professional orientation as a designer of the outdoor built environment and the focus of the department of study. This central focus is in recognition of the importance of reducing a research endeavor to a manageable level by limiting consideration to one dimension

of the problems of the world (Leedy & Ormrod, 2013). Throughout this endeavor, it is remembered that a complete successful solution toward improvements in overall societal physical activity levels includes elements of behavioral, social, and physical environmental influence (Sallis, et al., 2000).

This research will build on the 2012 pilot study with more rigorous protocols in an effort to add to the body of design evidence toward specific physical elements in the outdoor public park and playground setting. It will address the aims and hypothesis through observation of three park and playground environments within a setting where demographic and amenity variables are considered controlled (Hurst & Lee, 2014). The pilot study and this research are approved by the Texas A&M University Institutional Review Board (IRB) as having exempt status (IRB2014-0294M). Approved IRB Outcome Letter and IRB revisions are in APPENDIX FOUR.

This introduction will be followed by a review of the relevant body of literature addressing the contribution of play to healing, active living, outdoor physical activity, inclusion, universal design, perception, measurement protocols, and finally the 2012 pilot study. The pilot study is given a brief review and then reproduced in its entirety by permission from the Council of Educators in Landscape Architecture (CELA) journal *Landscape Research Record* (Hurst & Lee, 2014) in APPENDIX THREE. The literature review in Section 2 is followed in Section 3 with the theoretical framework and then a statement of the aims and hypothesis in Section 4.

Ecological momentary assessment methodologies and study procedures are outlined in Section 5, Methods. The data is analyzed using descriptive statistics and further analyzed using ANOVA and Zero-Inflated Negative Binomial Regression to establish and verify the significance of the data in Section 6, Results. The exploratory qualitative analysis will also be carried out relative to the locational data that was gathered, the attributes of the park and

playground that are being used, and the energy expended in physical activity measured in METs within the various areas. Section 7 will present a summary, a discussion of the findings of the analysis and associated conclusions and limitations of the study.

1.3 Delimitations

The research seeks to focus on evaluating the contribution of specific elements of outdoor open space to overall public wellbeing through measuring the ways UD affects playground use by way of momentary observation without the benefit of surveys or any type of interaction with the user public. It will be conducted in the diverse and specific outdoor environments of three open public parks in a single city having a homogeneous demographic, limiting generalizability to the single city setting of the study. The setting and the three parks were selected for the research because the park similarities lend to establishing a reasonably controlled environment for comparative research, yet they are not identical and do have some differences which will be evaluated in the process of the analysis and could also limit generalizability.

As a result of the City's homogeneous demographic, effects of population demographics and area land uses will be reported and evaluated to be considered controlled. Park variables such as benches, picnic tables, tree canopy cover, etc., will be recorded and also analyzed as variables that have the potential to affect use but are at similar levels across the three study settings and are therefore considered controlled. Measurements will be subject to the ephemeral conditions of the weather and the environment including all of the variables of outdoor park operations and management. Evaluation of these factors should be considered as they affect overall generalizability.

2. BACKGROUND AND LITERATURE REVIEW

The design of children's play environments or "playgrounds" has often been considered a simple endeavor, easily accomplished by anyone, without much in-depth consideration. In parallel to fine art, the design of the most successful play environments is a highly disciplined process. Done successfully, it combines principles from child development, kinesiology, and active living, therapeutic contributions of nature, social inclusion, and environmental perception combined through the discipline and practice of Landscape Architectural design.

2.1 Background

"Play is the child's work. The world is his laboratory, and he is the scientist". Good design creates a child's world where the child is at home and the adult is the outsider creating the opportunity for children to create a multitude of play experiences through trial and error. The physical elements of playgrounds, the equipment that defines them, and the spaces they create can be used to make a variety of links to further enhance the choices in play and increase the creative element of spontaneous choices in free play for the child (Friedberg & Berkely, 1970). A recent study of obese adults identified a playground as a specific destination leading to increased walking behaviors (Lee, et al., 2013b).

2.1.1 Playground Overview

Free unstructured play makes an important contribution to the lives and development of children, it is unfortunate that play is so easily taken for granted. Free play has been shown to have developmental benefits in children in the areas of cognitive, social, emotional, and physical development (Thompson, 1992). In addition to these important facets of child development,

play has also been shown to reduce stress (Frost, 1992). With the current societal addiction to screen-based media and the resultant obesity epidemic in adults and children, being outdoors has been identified as an indicator of increased physical activity and play (Moore & Cooper Marcus, 2008).

Research has shown that play is a necessary ingredient of child development and contributes to the human experience in ways we are just beginning to understand. The contribution play makes to childhood and healing has been recognized as early as the beginning of the 20th century (Marcellus, 2004). Early contributors to the field of child development such as Piaget and Vygotsky recognized play as a function of childhood growth thereby leading contemporaries such as Brown and Frost to focus on the developmental values of play (Brown & Vaughan, 2009; Frost, 1992; Vygotsky, 1978; Piaget, 1962).

The United Nations, in their 1959 resolution "Declaration of the Rights of the Child" stated that "The child shall have full opportunity for play and recreation, which should be directed to the same purposes as education; society and the public authorities shall endeavor to promote the enjoyment of this right" (U.N. Resolution 1386, 1959). This official recognition gives full legitimacy to the value and contribution play makes to a child's development.

The Americans with Disabilities Act (ADA) in 1990 and the 2010 ADA Standards for Accessible Design, are extending inclusion into public parks. Play environments in public parks are critical settings for getting children and their families outdoors, active, and interacting with each other (Prellwitz & Skar, 2007). As a response, the design disciplines are going beyond the minimum AD standards by applying UD principles making play places usable by people of all abilities without the need for adaption (Goltsman, 2011), making inclusive environments more attractive places for everyone (Moore & Cosco, 2007) to go outdoors and engage in healthy physical activity and active living (Kerr, 2007).

2.1.2 Historical Setting

The last half of the 19th Century in America brought an increased awareness of recreation and outdoor space. With the construction of Central Park in New York and collaboration with the World's Colombian Exposition of 1893 in Chicago, Fredrick Law Olmsted became a leader in the park movement of the time. As a part of the City Beautiful Movement new parks were being built in more accessible locations for the well-being of the working class (Newton, 1976). Park advocates of the time became natural allies of the playground movement. They promoted parks becoming "a place for families to do more together and for family life to be strengthened." (Cranz, 1982).

Along with the focus on public open space, the subject of outdoor play and playgrounds for children became an active topic. The first publication illustrating playgrounds was published in 1848 by Henry Barnard showing the playground in a school setting with teachers guiding young students in traditional games (Moore & Cooper Marcus, 2008). In 1885, a large sand pile, called a "sand garden", was made in the yard of a Mission in Boston. In Chicago, a "model playground" was built in 1892 at Hull House. These projects in many ways marked the beginnings of playground development in America and gave direction to the future (Newton, 1976).

By the turn of the Century, playgrounds were being built in new parks all across the country. Open air gymnasiums and sand gardens were being built across Boston. Many cities including New York, Chicago, Philadelphia and San Francisco had built playgrounds before the turn of the century (Cranz, 1982). In 1900, the Massachusetts Legislature authorized the City of Boston to borrow funds for twenty playgrounds. The Illinois Legislature authorized the issuance of $1M in bonds for the construction of small parks and pleasure grounds in 1903 (Newton, 1976).

In response to a growing interest in recreation and athletic facilities, the Playground Association of America (PAA) was founded in 1906 (Cranz, 1982). The need for playground safety and design recommendations began to be recognized with the publishing of the PAA recommendations for the "essential apparatus" public playgrounds used by girls and boys less than 10 years old (Wortham, 1992). Shortly thereafter, in 1914, a landscape architect, Henry Vincent Hubbard, published a paper in the American Society of Landscape Architects (ASLA) journal, Landscape Architecture Magazine, entitled "The Size and Distribution of Playgrounds and Similar Recreation Facilities in American Cities". Hubbard's paper outlined a description and classification of recreational facilities and playgrounds which was well received and became generally accepted (Newton, 1976).

Support for parks and recreation grew through those early years and with it the PAA went through several name changes finally leading to the establishment of the National Recreation Association (NRA) in 1930. The association expanded in the years of WWI in an effort to improve the poor physical fitness condition of prospective recruits with fitness training services (Social Welfare History Project, The, 2013). In the decade following the war, focus shifted back to domestic issues, the association then published additional guidelines for pre-school and public school playgrounds (Wortham, 1992).

Following the Second World War, the role of play and playgrounds grew into a thriving industry. There was resurgent interest in building playgrounds supported by educators, design professionals and a growing new industry of manufacturers. Research in child development supported the growing interest in play and fostered creation of more creative playground design. Many of the playgrounds of the period were built around fantasy play with a variety of themes. New developments in manufacturing brought aluminum molded castings and color through new

paint development. Modular equipment and the concept of continuous play began to dominate the market (Wortham, 1992).

In 1965, the NRA merged with the American Institute of Park Executives, the National Conference on State Parks, the National Recreation Society, and the National Association of Zoological Parks and Aquariums to become the National Recreation and Park Association (NRPA) which is active today in all facets of park and recreation issues (Social Welfare History Project, The, 2013). The latter decades of the 21st century saw an increased awareness of child development, play theory, and playground safety. An effort to write standards for playground areas began in the late '70s with the study of emergency room records in the National Electronic Injury Surveillance System (NEISS), identifying various injuries to children and their causes. The U.S. Consumer Products Safety commission first published its guidelines for public playground safety in 1981. This document underwent a major revision in 1991 and was followed by other playground standards focusing on playground issues such as equipment, surfacing, and accessibility for people with disabilities. Briefly, an outline of the major documents driving playground safety and development today is as follows:

- Consumer Product Safety Commission (CPSC) two volume handbook--*A Handbook for Public Playground Safety, Vol. I: General Guidelines for New and Existing Playgrounds*, and *A Handbook for Public Playground Safety, Vol. II: Technical Guidelines for Equipment and Surfacing*, published 1981.
- Americans with Disabilities Act of 1990 (ADA) and the Americans with Disabilities Act Accessibility Guidelines (ADAAG), 1991.
- CPSC *Handbook for Public Playground Safety*, Document #325. Originally published November, 1991 as a major revision to the 1981 document.

- American Society for Testing and Materials (ASTM), ASTM F 1292. *Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment*. Originally published in 1991.
- ASTM F 1487, *Standard Consumer Safety Performance Specification for Playground Equipment for Public Use*. Originally published in 1993.
- ASTM F 1951. *Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment*. Originally published 1999.
- 2010 ADA Standards for Accessible Design. U.S. Department of Justice, September 15, 2010.

These standards and guidelines have evolved over a period of more than 30 years and are critical to follow when developing a playground in the public environment. The 2010 ADA Standards for Accessible Design have come as a result of over two decades of study and revision into their final form and are Federal Law. The ADA Standards and their implementation are the core focus of this research.

2.2 Literature Review

The literature review was conducted over a period of years beginning in the fall of 2011 with continuous revision through 2016. The search was done primarily through the Texas A&M University Library access to the EBSCO database of scholarly (peer reviewed) journals. A number of early works were taken from previous academic and professional exposure.

2.2.1 Child Development and Play

Growing and learning in childhood is commonly divided into four equal dimensions of social, emotional, physical and cognitive development. Play in many ways becomes a medium for development, applying these components as children gain information about themselves, their bodies, their friends and the new world in which they live. Each of these dimensions has an equal contribution to the development of a child. Social development involves concepts of how children relate to others in sharing, turn taking, listening, negotiating and other interactions with children and adults in healthy cooperative associations. The emotional dimension relates to how a child understands and feels about themselves internally such as happiness, sadness, contentment and anxiety. Cognitive development is the actual refinement of thought processes expressed in play through choices such as where next to put a hand or foot in the act of climbing. Physical development is probably the most commonly thought of benefit of play where through running, jumping and climbing children develop their muscles, balance and coordination (Thompson, 1992).

There are four phases of development in Piagetian theory from birth to adulthood where play and these four dimensions of growth interact. The first phase is the Sensory Motor Stage which takes place from birth to approximately 2 years of age. This stage is considered the core of experience on which a child gains the basic foundation of his or her abilities. Information is gained through exploration and the basic sensory experiences of sight, sound, touch, smell, and taste. Through exploration and play in a safe environment, a broad experience base will contribute to more complex development and thinking in later phases. The Pre-Operational Stage in approximately years 2 to 7 is characterized by perceptions of time, space, and cause and effect. During this stage, a child begins to understand time and more complex spatial concepts such as under or between. Children begin creating dramatic play experiences and integrate

movement skills such as balancing, climbing, jumping and other fine motor skills. In years 7 to 11 children normally enter the third stage, the Concrete Operational Stage. In this stage, children begin playing more games with rules, continue with symbolic play and fantasy games and begin formation of friendship relationships with their peers. The final stage is the Abstract Operational Stage where children over 11 years old begin thinking in ideas and play is expressed by greater interest in sports. Relationships in peer groups begin to take on primary importance at this stage (Thompson, 1992).

Child Development through Play

Piaget identifies the importance of imitation and play divided into six stages in early childhood. Imitation in children is an adaptive behavior where play involves the relaxation of the behavior simply for pleasure. The first stage of play is of reflex adaptions. As play progresses to the second stage, the child engages in simple games such as moving the head and hands in primary circular reactions accompanied by smiles and laughter. In the third stage, the child adds to the movement of his or her own body, the deliberate movement of objects. Play in the fourth stage reflects more complex thought where the child learns to move an object to gain an objective. The fifth stage involves what is termed tertiary circular reactions which involve a sort of play experimentation in order to see the result. The sixth stage departs from the need for physical objects and enters in the concepts of symbolism. Play through all of these stages is for pleasure and is accompanied by smiles and laughter (Piaget, 1962).

In contrast to Piaget's focus on pleasure, Vygotsky specifically states that play has an enormous influence on a child's development but pleasure is not considered as a defining characteristic of play. When a child enters the age of preschool, play allows children to enter into an illusory world where unrealizable desires can be realized through imagination. This

imaginary world is filled with self-imposed rules formulated to structure the imaginary situation. The creation of rules for the new imaginary situation is the first evidence of a child's elevation from situational requirements. In this imaginary situation, the child through rules adopts a line of least resistance because play is connected with pleasure but also learns to follow the line of greatest resistance by submitting to the self-imposed rules. This attention to rules and subordination of impulsive action is said to be the path to maximum pleasure (Vygotsky, 1978). Therefore while in Vygotsky's mind, play isn't defined by pleasure, pleasure is certainly a component of play.

Human children aren't the only creatures that exhibit the behaviors of play. Animals from mammals down through birds, reptiles, and fish have been observed in play. In a utilitarian sense, play has been shown to allow animals to prepare themselves for changing conditions in a continuously evolving planet. Play allows bears to test each other in non-threatening ways during play to learn about reactions and rules of engagement from friend or foe in an environment where life and death are not at stake. Animals also play to learn how to navigate their world and are better able to adapt to it. They are able to test out situations without threatening their own well-being. Individual animals that play have been found to have more brain development than those who don't. In animals that don't play, neural growth has been found to be in only one part of the brain as opposed the whole brain growth in those that play. Essentially, play has been shown to stimulate brain growth, add to intelligence and improve survival through adaptability (Brown & Vaughan, 2009).

Play and Behavior

In parallel with our animal counterparts, spontaneous, free play in children is one of the most important and most beneficial types of play. Free play has five dimensions identified by

play scholars and researchers. Free play is primarily voluntary, allowing participants to enter or leave at will. Free play is spontaneous, at any time it can be changed by any of the players. Free play is imaginary, it involves a pretend element that is different from everyday life. Free play is engaging, players are separated from other activity as they engage in the play activity. The fifth dimension of free play is simply being fun, pleasant and enjoyed by the participants (Frost, et al., 2004).

During the second year of life, children begin to gain the ability to engage in self-directed pretense or pretend play. The act of exaggeration, play sound effects and "knowing" laughter are all signs of pretend play in comparison with functional play. Sometime around a child's second birthday, most children are capable of object substitution or intentionally treating an object as if it were something different. Play behaviors such as drinking from an empty cup are considered by some researchers to be the beginning of pretend play or pretense (Frahsek, et al., 2010).

Many health care professionals and educators consider play makes an important contribution to a child's development. It is a process where children can develop through interaction with their physical and social environment on their own terms. In free play, children's reading readiness and sociometric status among their peers are readily seen through their play behaviors. These play behaviors have an appearance of indicating future levels of functioning. One type of behavior, rough and tumble play (R&T) is frequently seen in free play behaviors such as play chasing and play wrestling. Indicators of R&T are behaviors like a laugh, smile, run, chase, flee, wrestle, and play noises. This type of play is sometimes confused with aggressive behaviors but there is a distinct difference in facial expressions and in the behavior of switching roles from being the aggressor to being the victim. In this behavior, children have an

opportunity to learn and practice social interaction roles in a non-threatening way (Pellegrini & Perlmutter, 1988).

Benefits of Play

A connection between play, learning, and overall development has found support in studies finding that play and physical activity contribute to cognitive development. Increased physical activity in school, through a short exercise program, was shown to increase achievement test scores in children (McCreary, et al., 2012). Complimenting cognitive development, pretend play engages all parts of the brain triggering synaptic connection development for overall growth. From another perspective, research has shown that social play develops skills in social competence and development of good interventions successfully preparing a child for the demands of life. Conversely, research has shown children deprived of normal play experiences can be prone to hostility and depression. A more extreme link in research has been found between a lack of play in childhood and social deviance in adulthood resulting in incarceration (Frost, et al., 2004).

While play can have a much greater contribution to child development and the human experience than simply expending energy or blowing off steam, it certainly does have a component of a contribution to active living. The World Health Organization (WHO) has warned that a sedentary lifestyle is a global public health problem. Obesity in both children and adults has seen double-digit increases along with the accompanying increase in risks for cardiovascular disease. The Center for Disease Control (CDC) has found a direct correlation between the amount of TV a child watches and measures of their body fat. A natural benefit of outdoor free play is that children are more physically active which can be a counterweight to the epidemic of sedentary lifestyles leading to obesity (Louv, 2008).

2.2.2 The Role of Play in Healing and Active Living

Advances in medicine and healthcare have had a profound effect on life. As recently as the turn of the 20th Century, nearly half of the infants born would not see adolescence. Children then were thought of in the medical community as small adults and treatments were prescribed as such. Gradually, through research, pediatrics emerged in response to the special needs of children. Even in those early times recognition was given to healing by nature's method. The health benefit resulting from play was acknowledged in the typical tuberculosis preventorium routine that included fresh air, exercise, good food, sunshine, and play in an effort to restore a child's health (Marcellus, 2004).

Treating Stress of Illness through Play

Despite all of the advances in physical medicine, the psychological side of hospitalization has long been under-treated. Studies have found that children and youth still find being hospitalized as being stressful (Adams, et al., 2009). Children have been found to experience heightened stress levels as they begin feeling more vulnerable and have less control over their environment, their activities and their own bodies. There have been tremendous gains in the treatment of childhood cancers. The stress and anxiety of these treatments and those from other illnesses are still elements that the child patients have to cope with. Illness related issues such as nausea and vomiting, gastrointestinal disorders, visible side effects and other less visible effects negatively impact a child's sense of psychological and social well-being. Play has been shown to reduce stress levels in highly anxious children. Play allows children to escape the reality of the hospital and their condition and temporarily regain some sense of control of their lives. Through play, a child can re-enact a stressful experience taking on different roles and gain a better understanding of the situation. The play experience allows the child to behaviorally

adapt strategies that may help cope with the stress of the hospitalization and treatments (Gariepy, 2003).

Children in a hospital environment who are anxious about their treatment and outcome have been shown to use symbolic play to relieve stress and anxiety. Often toys that are medically related can allow the children to transfer their fears and anxieties to the objects rather than people and thereby reduce their anxiety levels (Gariepy, 2003). Therapeutic play has been used to help hospitalized children cope with the stresses of their condition and upcoming treatments and surgeries. Using established developmental theory, children have been evaluated for their anxiety levels after enacting parts of the surgical process before going themselves into surgery. Both the children who received the play intervention, and their parents reported lower state anxiety levels both in the pre-operative and post-operative periods than did those who were only told of what to expect. Studies have shown that an individual's evaluation of a potential threat is relative to their perception of control over the event. Play therapy in this sense is used as a strategy to improve a child's understanding of an event in an effort to have an improved feeling of self-control thereby reducing state anxiety levels and stress (Cheung, et al., 2008).

While most play advocates are also advocates of outdoor play and that dimension of play has been shown to be valuable, not all children in a hospital environment are able to go outside, some are unable to leave their rooms. One therapeutic play intervention study looked at the effectiveness of using virtual reality computer games as an avenue of therapeutic play for children who were found to report high scores for state anxiety when admitted to hospitalization with cancer. Many of them expressed degrees of sadness and worry, being at risk of depression. The study reported that children receiving the intervention of the computer game had fewer depressive symptoms than the children who did not. It was thought that one reason was the regained sense of self-control over the unfamiliar and threatening environment (Li, et al., 2011).

Healing and Play

Play can be both an adjunct to the healing environment and it can become the treatment itself. Through play, children establish a relationship both socially and physically with the world around them (Moore, 1999). In therapeutic play, play is specifically the conduit for the treatment. Children that have been subjected to abuse or other troubling conditions are often in need of therapeutic help to enable them to establish sustainable attachments with others and to experience the normal pleasures of life. Therapeutic play has been used as an intervention where play becomes the primary vehicle of communication and healing. When children were given play therapy in addition to the standard therapies, researchers have found that children receiving the play therapy were becoming more normally adjusted and were less isolated. More research needs to be done in this realm to establish the duration of effectiveness (Carroll, 2000).

Emotionally, when children play, they benefit from support in coping with stressful events and situations. Play can become a distraction from distressing events and it can give children an opportunity to play out the many frightening and stressful experiences hospitalization brings. As play is a normal childhood activity, chances to play in the hospital are critical to a child's well-being regardless of their abilities or challenges. Many children in the hospital have restricted movement caused by their condition or devices designed to immobilize limbs for healing. While play is important for children who are able-bodied, those who need assistance to get around are in great need for the positive influence play will bring to their lives. It has been shown that a properly designed structural element in the play space will have a positive influence on play activity. Children hospitalized with physical handicaps were found to have increases in time spent in varying modes of play and a concurrent decrease in idle and aimless behaviors (Eisert, et al., 1988).

Although going outdoors may not always be possible because of treatment circumstances or climactic conditions, it has been suggested that when possible, children who are in an institutional setting such as a hospital should be given the opportunity to go outdoors to play on a regular basis. Going outdoors to play sometimes involves simply blowing off steam but it is so much more important than only that. Children in school have been found to play more vigorously following extended confinement to their classrooms and the parallel lack of motor stimulation in an institutional setting can become a real problem. Child life specialists and nurses should encourage children to engage in all types of play, including rough and tumble play if their condition allows. Those in supervisory capacity should be trained to recognize the legitimate differences between rough and tumble play and aggression. They also need to discourage a child from taking on a passive sick role in play that can potentially have a less than positive effect on psychological health (Pellegrini & Perlmutter, 1988).

Overall, children in healing institutions such as hospitals are seen to use outdoor environments differently than adults. This is both natural and healthy. Adults have reported the stress relieving benefits of being outdoors but overall, they are often content to simply be in a natural setting for stress relief. Conversely, children tend to prefer spaces where there is opportunity for active use and that encourage creative, imaginative and physical play. Even the youngest children are likely to be actively engaged in explorative play. Four and five year olds liked to climb, run and jump. Older children between six and ten often requested things to do in an apparent need to have a more structured environment for play. All of the ages appeared to like animal forms although studies have shown abstract art should be avoided. One of the most universally important elements of the outdoor environment in a hospital is communication of its existence, location and purpose (Whitehouse, et al., 2001).

Recent post occupancy research has shown an expressed need for outdoor recreation in the built hospital environment (Varni, et al., 2004). In a more specific survey, children recommended more interactive activities for play (Whitehouse, et al., 2001). More importantly, repeated studies have stressed the importance of asking the children for their opinion. While asking the children is more difficult and potentially involves more Institutional Review Board hurdles, it is an important and critical element in designing facilities for children's use (Carroll, 2000; Adams, et al., 2009).

2.2.3 Nature, Play, and Health

From Jens Jensen to Aldo Leopold the value of nature has been extolled as if we have all somehow forgotten our origin. We have been again reminded by the contemporary works of E. O. Wilson, Stephen Kellert, and Richard Louv of the link between well-being and nature. A striking explanation may be found in simple economics, where everything in society is given a value. Some are deemed of extraordinary value because of the quantifiable benefits they bring. Others are taken for granted because they are in the realm of the un-quantified or un-quantifiable. In many ways, nature works for us without any human investment or contribution to the effort (McHarg, 1969). The value these natural contributions bring to the human condition has been largely left un-quantified and undervalued. We can easily assign value to a home in terms of the materials and labor needed for construction but the value of a view to the mountainside is more difficult to quantify objectively.

Contribution of Nature

Studies have looked at the environment from three perspectives, the abiotic, the biotic and the cultural (ABC). Many of the ecosystems that are now considered environmentally

sensitive areas (ESA) make a biologic contribution to the overall diversity of an ecosystem. Maintaining habitat in natural physiographic units and within a contiguous area capable of sustaining wildlife contributes to species diversity and adds value when maintaining ecosystems. Other ESAs are important for their abiotic contribution to soil preservation and groundwater recharge, and some to reduce the effects of stormwater runoff potentially affecting the costs of flood damage and displacement downstream. The cultural element is where the value can be identified in an effort to save the abiotic and the biotic (Ndubisi, et al., 1995).

Ecosystem services provided by a healthy environment are now beginning to be recognized for their value. Natural benefits such as bees pollinating crops, filtration of water by soils, cleansing of air by vegetation, flood protection from woods and wetlands are "free" benefits that are beginning to see recognitions. The Sustainable Sites Initiative, sponsored in part by the American Society of Landscape Architects (ASLA), reported the worldwide ecosystem services were valued at approximately $33 Trillion in 1997 dollars (ASLA, 2009). Recently, the Landscape Architecture Foundation (LAF) has begun to provide the profession with definition and calculation methods for quantifying elements of ecosystem services (LAF, 2013).

As a result of our evolution in nature, the human race has evolved as biologic beings. Many would contend that having evolved as natural beings before becoming cultural beings, humans are naturally programmed psychologically to better cope in the natural environment than in the urban environment (Ulrich, et al., 1991). Our success in life has often been thought to include competition with and the conquering of many natural elements. We have in some respects forgotten our connection with nature and at the extreme have intentionally associated progress with the conquest of nature. In the process, we have conveniently forgotten or ignored nature's contribution to our well-being. Clearly, there is no going back to the agrarian society of

past centuries, nor should there be a desire to. What needs to become, is an understanding and valuation of how much our physical and mental health and our overall well-being are reliant on being in association with nature rather than being apart from nature (Kellert, 2012).

Environmental Stress and Nature

Nature is constantly being pushed out of our world with assaults from the screen based media. School-aged children have been found to spend around 30 hours a week consumed with different types of screen-based media such as televisions, computers and smartphones (Louv, 2008). Guidelines recommend sixty minutes or more of activity per day in enjoyable moderate to vigorous physical activity including healthy outdoor play. Fewer than half the school-age children currently meet these guidelines (Huberty, et al., 2011). A study by the University of Michigan on television and children reported that watching television can lead to higher incidences of violent behavior, earlier sexual activity, lower performance in school, fright, and sleep disorders (Michigan, 2013).

Around the country, some of our national and state parks and wilderness areas are seeing a reduction in visitation in excess of 25%, several studies have suggested this is a reflection of increased media time. Recent studies have reported that this accumulation of time with screen-based media is showing a correlation with mental health disorders. The second problem with this cyber overload is the resultant reduction in meaningful social interaction and physical activity. With this loss of contact with nature, is an accompanying loss of a layer of physical and psychological resiliency (Logan & Selhub, 2012).

We are clearly protected by law from assault by acts of violence but have no protection from glare, noise and stress introduced into our living environment (McHarg, 1969). The stress of life has been related to many of our physical illnesses and has been identified as a real

obstacle to healing (Ulrich, 1999). Much of the study on stress is based on personal elements of stress such as coping, and the perception of control. Environmental stresses and stressors such as noise, crowding and pollution is also getting increased attention in research (Ulrich, 1991). Studies have been done in the ordinary living environment and in a number of institutional living environments.

Common sense would suggest that exposure to nature and natural elements such as trees and water elicit feelings of psychological well-being and result physiologically in restoration from stress. The autonomic nervous system is divided into two categories, the sympathetic nervous system and the parasympathetic nervous system. The sympathetic nervous system's primary function is to energize and mobilize the body for action making it of considerable importance to research in stress and recovery from stress. This system of activation and alert, consumes energy in the body and is draining on physical resources. Complementing the sympathetic nervous system is the parasympathetic nervous system which restores bodily energy and resources. Physiological measures of stress include electrocardiogram (EKG), pulse transit time (PTT), spontaneous skin conductance responding (SCR) and frontalis muscle tension (EMG). The measures of EMG and SCR have been found to increase during stress and decrease during recovery, conversely, PTT decreases during stress and increases during recovery (Ulrich, et al., 1991).

It should be recognized in discussion of the healing benefits of nature, that there are some things in nature such as spiders, snakes, and a howling wolf, naturally result in a response of fear in many people. These elements are categorically excluded from the discussions of the positive benefits of nature. When nature is discussed, it should be considered that the intent is to discuss the unthreatening elements of nature. These positive, unthreatening elements of nature will be simply referred to as nature (Ulrich, et al., 1991).

In environmental psychology, arousal theory would suggest that urban settings will have a negative effect on stress recovery while natural settings will have a positive influence on stress recovery. Expanding on the theory, it could also be expected that urban settings with light traffic will have less negative influence than those settings with heavy traffic. These hypotheses have shown support in research that found recuperation from stressors to be faster in subjects exposed to natural environments as opposed to urban environments. Complimentary to the reduction in response from the sympathetic nervous system, there is also a possibility reported that the parasympathetic nervous system responds to the natural environment rather than the urban environment. Subjects indicated a lowering of arousal and more feelings of positive effects when exposed to the natural environment in recovery. These findings show support for the restorative effect that everyday natural outdoor environments have on both physiological and psychological components of stress (Ulrich, et al., 1991).

Preferences of Nature and Healing

Within the urban environment, nature is often referred to as a landscape setting of woods, green open spaces, and green plants. The built environment in an urban setting consists of elements that are constructed or cultural in character being visually characterized by lines that are regular and rectilinear with sharp and abrupt transitions as opposed to the irregular and curvilinear lines with gradations of shapes, colors and textures of the natural environment. Study of a psychiatric hospital in an institutional setting revealed a preference among both patients and staff for natural settings in a photographic analysis (Barnhart, et al., 1998). Another photographic preference study showed a similar preference for natural elements and settings among assisted living residents (Rodiek & Fried, 2005).

Modern medicine has begun to recognize the value of nature in treatment of disease. In a review of hospital records, Ulrich found contact with nature in gall bladder surgery patients having a view through their window to trees recovered more quickly and averaged nearly one day less in the hospital with fewer complications than those having a view of a brick wall (Ulrich, 1984). More recently, a study was done involving the application of natural sights and sounds in distraction therapy for patients having stressful and painful flexible bronchoscopy procedures. In the study, patients were exposed to scenes of nature and sounds of running water and birds singing with positive findings of reductions in reported stress and pain during the procedure (Diette, et al., 2003).

Landscapes themselves have been found to have degrees of therapeutic value. These landscapes are often in locations associated with healing and can be places where the physical environment joins with social conditions and human perception to result in an atmosphere of healing. Some of these landscapes are spiritual in nature. There are a number of old world examples of pilgrimage sites. In the new world, one of the oldest sites is the Basilica of St. Anne de Beaupre in Quebec, Canada. This is a Roman Catholic site where the first Basilica was built in 1658 and reports of miraculous healings were made as early as 1667 (Williams, 2010). Others consider the therapeutic and restorative benefits of extraordinary landscapes, or those landscapes people encounter only for a limited time, outside of the experiences of normal life, such as Denali National Park, Alaska (English, et al., 2008).

An offshoot of this body of thought comes with the concept of medical tourism. There is an established history of people traveling for healing through yoga, spas and therapeutic youth camps. A growing movement in the world seeks to combine advanced medical procedures, offered at very competitive costs to those who are in need and are self-insured. The concept involves combining medical services with relaxing destinations for a holistic approach to

surgery, recovery and therapy (Buzinde & Yarnal, 2012). These would generally be considered as extraordinary landscapes.

On a regional scale, the introduction of the emerald ash borer into the upper mid-western United States has resulted in the loss of 100 million trees. This has provided an opportunity for a natural experiment looking into the contribution forest canopy cover provides to human health. The study found that tree loss as a result of the borer was positively associated with an increase in mortality from cardiovascular and lower-respiratory illness (Donovan, et al., 2013).

Contact with nature and trees have been the overriding theme throughout these studies. This research shows correlation between health and nature and an equal correlation between stress and lack of nature. In the urban context, public parks can serve as a readily available avenue for contact with nature. As such, physical elements of the parks that draw people outside and into nature can have some healing benefit whether it is quantified or remains qualitative.

2.2.4 Play and Outdoor Physical Activity

Sedentary lifestyles and the associated health effects and risks have become a global concern. In current estimates, more than 33 percent of children and adolescents are overweight or obese (Kerr, 2007). A recent survey showed over 65% of adults over 20 years old to be overweight or obese (Lee & Moudon, 2008). Physical inactivity in adults has been reported at about 25% and recommended moderate to vigorous activity levels were reported at less than 40% of the adult U.S. population (U.S. DHHS, 1996). In children, physical activity at recommended levels was reported at under 50% in all gender and racial categories (Kerr, 2007). Accompanying these inactivity and weight levels are increased risks to cardiovascular and other diseases. Many of these diseases which were adult diseases, once considered a result of aging are now being diagnosed in children (Kerr, 2007).

More than 860,000 deaths occurred in the United States attributable to heart disease and stroke in 1992. A major risk factor for cardiovascular disease (CVD) is high blood pressure which affects about 50 million people, of whom an estimated 2.8 million are children and adolescents between 6 and 17 years old. People with low levels of cardiovascular fitness showed a strong association with increased mortality. People who are sedentary have a 1.2 to 2 fold increase risk of dying in comparison with people who lead an active lifestyle. Findings in physical activity and health research support the effect moderate levels of physical activity can have to protect against these diseases and others. Among sedentary people, moderate elevation of physical activity is likely to be more realistic with sustainable reductions in health-related risks being more readily achievable (U.S. DHHS, 1996).

Physical Activity Interventions

The literature generally supports three categories of physical activity intervention: behavior, policy and environment. Many researchers focus on interventions that promote behavior change among individuals and small groups. Getting people "off the couch" does require behavior change and that is a critical dimension to improving activity levels among our population. These initiatives can include school and workplace incentives or programs. One program introduced a sort of exercise routine into a school district that was a ten minute, in class, physical activity break. The longitudinal study assessed the BMI of students who had been at the school participating in the program from first through fourth grades with students who transferred into the school. It found that the students exposed to the intervention had a mean BMI difference of 0.9 points ($p<0.05$). It also found that academic performance improved over the time period as measured by the Illinois State Achievement Tests (McCreary, et al., 2012).

Policy changes would include inducements to be active such as walking school buses, and school programs for physical activity such as formal physical education (PE) and recess time, many of which have become absent from our school curriculums. Using existing facilities by promoting extended operating hours for school and malls can enable members of the community to be more active by providing a safe, all-weather venue for physical activity with little or no capital investment. Efforts to raise awareness and promote physical activity fall within the realm of policy initiatives. The American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) joined with the American Heart Association and the American College of Sports Medicine to form the National Coalition for Promoting Physical Activity to coordinate a consistent message about physical activity while striving to promote awareness of the benefits of active living. The U.S. Center for Disease Control (CDC) has published guidelines promoting healthy eating and physical activity among young people and has initiated a public effort campaign to encourage active living among youth (U.S. DHHS, 1996).

The third dimension of active living, the physical environment and changes to it, involves facilitating activity through amenities in the built environment. Physical elements in the environment have been the central focus of this paper as a result of the author's professional orientation as a designer of the outdoor built environment and the focus of the department of study. It has often been found that physical changes to the environment make a more lasting contribution to improved physical activity habits than do programmatic or policy changes alone (Sternberg, 2009). Nevertheless, a complete successful solution to improvements in overall societal physical activity levels do include elements of behavioral, social, and physical environmental influence (Sallis, et al., 2000).

In addition to the physical benefits of active living are the cognitive benefits of physical activity. As school administrations are slashing physical education (PE) and recess time in favor of classroom learning, they are missing the connection between cognitive growth and physical activity. School studies that introduced active living programs into schools reported two primary benefits in the schools that initiated the exercise programs. First, school principals expressed that student visits to the office representing reprimands for behavior problems dropped dramatically (Huberty, et al., 2011). The second effect was that scholastic performance rose and the school surpassed the average scores for the district on the Illinois State Achievement Test (McCreary, et al., 2012).

Influence of the Built Environment on Physical Activity

Modern technology meant to provide mechanical assistances in an effort to ease travel burdens, has reduced our need for physical activity. The motor car, has allowed us to travel longer distances for work, recreation, goods, and services. People no longer need to live near where they work, shop or recreate. It has brought with it a clustering of like land uses increasing distances of destinations from origins. When people do live within a short distance such as a quarter mile to a destination, habitual use of the automobile often reduces the propensity to walk. Technological innovations such as elevators, escalators, and people movers in our buildings, shopping malls and airports have reduced the need to walk and climb stairs in daily living. Coupling these unintended barriers to physical activity with a lack of walking trails, sidewalks and obstacles created by high traffic roadways and expressways completes the effect of a built environment that is uninviting to physical activity.

The opportunity to exercise as it relates to the availability of facilities in the built environment has been identified as having a positive correlation with physical activity in both

children and adolescents (Sallis, et al., 2000). Specific elements comprising this opportunity such as existence of and access to recreational facilities have been identified as important contributors to physical activity. Population density, land-use mix and street patterns have also been studied with positive correlation although it is noted that studies of street patterns often omit pedestrian networks which may significantly underestimate connectivity. It is interesting to note that perception of the environment can differ between two individuals causing a completely different behavioral response within the same physical environment (Brownson, et al., 2009; Lee, et al., 2013a).

The presence of parks in a community and their contribution to active lifestyles are gaining the benefit of a growing body of evidence. Many studies are showing a positive correlation between local parks and physical activity levels. Youth in Atlanta were two to three times more likely to walk if there was a park nearby than those who did not have local access to parks. Older adults in Portland were significantly more likely to report higher levels of walking if there were more recreational facilities and open green space available. Research in Ontario, Canada, showed that parks with more amenities, specifically paved trails, were more likely to be used for physical activity. In Cleveland, physical activity among children was studied in school playgrounds that had been renovated in comparison with those that had been left un-renovated. The study showed an increase in use by both adults and children in the renovated playgrounds and significant increases in activity levels among children in the renovated versus the unrenovated playgrounds (Mowen, 2010).

In England, a study showed parallel results of playground renovation. The project renovated playgrounds at 15 low-income schools using colored lines in an effort to stimulate play. In comparison with 11 schools that were not renovated, the study showed physical activity in the children was raised by approximately 30 minutes per week. In New Orleans, a study was

implemented in low-income neighborhoods that opened school playgrounds to after-hours supervised use by neighborhood children. In a two-year comparison with nearby neighborhoods having schools whose playgrounds remained open after hours, an 84% increase in the number of physically active children was reported. In addition to these playground studies, new evidence is showing that when children are able to walk or bike home from school, they engage in more regular and sustained physical activity. In Sweden, 4 to 6-year-old children who had access to natural green elements of trees, shrubs, and dirt were reported to have daily step counts increase by 20% (Kerr, 2007).

Street trees, benches, and lighting were identified as important physical elements for facilitating walking. Of these, lighting was mentioned regularly as an important contributor to walkability and availability of bike racks and continuous bike paths were added to the list of facilitators by cyclists. In addition to the existence of trails and pathways, simple interventions such as street trees, benches for resting and lighting have shown great promise to increase walking and bicycling activity among the overall population. On the personal level, having a dog showed a positive association with moderate physical activity, as a result, dog-friendly facilities also have the potential of facilitating active living (Lee & Moudon, 2008). These are examples of how micro-scale park elements and amenities can influence behaviors and use.

Over the past decades, society had begun to realize the extent of sedentary lifestyles and the cost of medical treatment and reduction in quality of life. Solutions to the issue involve many players and have multiple dimensions. Implementation of multi-faceted solutions will be needed to reverse the trend and increase physical activity and health in the population.

2.2.5 Inclusion of Children with Disabilities

The value of play has been demonstrated as a critical part of a child's life and development but it is important to recognize that playgrounds don't lead to positive outcomes for all children. In many environments children with physical impairments and disabilities have become marginalized and often their parents become marginalized as well (Jeanes & Magee, 2012). In some circles disability has been defined as a kind of social restriction that imposes limitations on the activity and interactions of people resulting in socially oppressive restrictions on children limiting interactions with their peers (Burke, 2012). An important element of play and the play environment is that it becomes a medium for communication and interaction with peers. Children of all abilities have reported the playground as a place that they can have privacy, especially from adults, and where they can interact with friends making playgrounds as much a social space as a space for activity (Prellwitz & Skar, 2007).

As a result, play environments for children and families are critical settings for inclusion because play is such an important facet of a child's development and family life. High quality inclusive play environments are needed to foster development in children of all abilities in an effort to reverse the trend of disenfranchisement of those with different physical impairments. In response to the need for inclusion, the concept of universal design in play goes beyond the minimum statutory requirements of the 2010 ADA Standards for Accessible Design. The concept seeks to design environments that are usable for all people, of all abilities, without the need for adaption to the greatest degree possible. Integration of universal design brings value to people of all abilities and ages to link children with peers and parents with parents in a recreational setting. The resulting universally designed environment has the potential to encourage more use by people of all abilities benefiting adults and children alike (Moore & Cosco, 2007).

Some basic elements of providing play environments for people of all abilities include removing physical barriers by providing a good accessible route and making sure drinking water and toilet facilities are available to everyone. The effect of limiting accessible play elements to a single specially designed space simply reinforces the social segregation that universal design seeks to overcome (Jeannes & Magee, 2012). Providing play equipment on an accessible surfacing ensures that people of all abilities can access all facilities. This discussion has focused on children with disabilities. There are many parents of able-bodied children that need to use mobility devices and who would like to or need to be able to accompany their children to the playground. The inclusive environment seeks to include parents and caregivers who have physical disabilities as well.

There has been much work done in the last ten years to develop accessibility standards around the world. In 2010, the Justice Department adopted a set of standards for accessibility with the 2010 ADA Standards for Accessible Design (U.S. DOJ, 2010). In it, they devote two full chapters to play areas themselves defining minimum requirements for accessibility of play area ground surfacing, play structure accessibility and accessibility requirements for play elements.

The Standards define a transfer platform that is allowable in smaller playgrounds. A transfer platform is designed to allow a child with mobility impairments who has some ambulatory capability, primarily one who uses a wheelchair for daily mobility, to challenge their abilities by transferring from the wheelchair to the platform and access the play structure. The Standards also define when ramps onto the play structure are required and how they are to be built (U.S. DOJ, 2010).

These Standards represent a good start toward inclusion and a statutory requirement for all facility construction after March 15, 2012. The minimum standards only require one-half of

the play elements to meet accessibility requirements, transfer platforms are allowed in smaller playgrounds and accessible loose fill surfacing is allowed that can shift to form humps and rolls if not frequently maintained, limiting accessibility. Going beyond the minimum standards includes making all or nearly all play features accessible, providing ramps to the majority of play features and using highly accessible unitary surfacing on the ground level is at the foundation of UD practice.

2.2.6 Perception and Affordance

There are many perceptual elements that promote attracting people outdoors. People who use the environment perceive it in a variety of ways which affects both their frequency and form of use and their perceptions of self (Kaplan, et al., 1998). Perception of the environment has been written about in terms of affordances which are physical elements that enable certain behaviors, and how these elements and behaviors make us feel (Gibson, 1979; Kaplan, et al., 1998). Affordances are part of behavior settings that are made up of the participants, the elements, and the activities in an environmental setting such as a park or a playground (Moore & Cosco, 2007). Measurement of these perceptions and attitudes allows researchers to communicate with designers of the built environment, attributes that will most successfully contribute to the desired outcome.

Stress, Perception, and Neural Connections

It has been long understood that stress affects brain function and studies have shown stress reduction can be a function of exposure to nature. From the perspectives of directed versus involuntary attention, directed attention can contribute to stress and involuntary attention that is often associated with being in or viewing nature contributes to restoration (Kaplan, 1995).

A more biological approach looks at the function of the sympathetic and parasympathetic nervous systems where the sympathetic nervous system creates arousal for action (fight or flight) and the parasympathetic nervous system relieves arousal (Ulrich, et al., 1991).

Measurement through the application of functional magnetic resonance imaging (fMRI) has shown resting state networks (RSN) including default mode networks (DMN) that are active during rest. Observation of the networks during rest and stimulation gives an understanding of how stress effects and overloads the brain. It has also shown a structural link in autism where these networks are more loosely connected than in normally functioning individuals (Soares, et al., 2013). These findings showed that even short exposures of 5 minutes or less to the restorative environments result in a restorative effect (Sherman, et al., 2005). Implications of application of fMRI to neural connections relative to visual perception have possibilities that could assist in understanding the design of the built environment with respect to the ways it is perceived.

Environmental Perception

As is the case with processing visual information in the different regions of the brain, much of the literature in environmental perception focuses on perceiver centered or top-down processing of the perceptual information. A part of the perceptual literature addresses a perception of self and self-identities of people who use outdoor public parks. As self-efficacy is a significant contributor to the effectiveness of a physical activity program (U.S. DHHS, 1996), self-image is often a central driver of activity in a public park or trail system that is re-enforced by the current experience (Lee & Moudon, 2004).

A child's self-perception is also a contributor to physical activity that is often driven by measures of peer influence including athletic competence and physical appearance. Their self-

perception, driven by outside information has been shown to be a critical determinant of participation and physical activity (Boulton, 2005). In many cases, children's images of play environments include the activities the environment affords. Complimentary to the activity the playground area affords, the perceptions for many children include interaction with friends. Negative perceptions are mostly centered on the dangers of the physical space with respect to personal injury caused by the objects (Pearce & Bailey, 2011). These examples have an effect on motivating behavior independent of visual or sensational perception.

In contrast with the negative fears of injury through risk, many children view risk as one of the attractive elements of a playground and part of the fun. From a child development perspective, some risk taking is healthy and provides the opportunity for cognitive growth in both physical abilities and in the ability to accurately appraise risks and understand potential severe outcomes. There are some children who are naturally attracted to risk and the intensified sensations become a reward for risky behavior (Little & Wyver, 2010). With the element of risk in play comes the growing debate on the restrictive nature of playground safety guidelines and the developmental stimulation some degree of risk affords. Parents, teachers and playground administrators often have perceptions of risk that are different than those of the child (Sandseter, 2012). Risk and the perception of risk plays a significant role in playground evaluation from both the perspective of safety and the perspectives of challenge and attraction and should be included in evaluations of perception of the playground environment.

Affordance and Perception

An analysis of perception is a human perception centered or top-down evaluation of the elements making up the physical environment that Gibson describes in terms of an ecological reality. This ecological reality brings meaning in terms of behavior to the environment rather

than just the physical being of the element. In the ecological reality, features and objects are expressed as affordances which are physical elements reflective of the behaviors they can accommodate. Examples of affordances are benches creating a place to sit, a roof giving shelter, and a fire providing warmth but also the danger of being burned (Gibson, 1979). These affordances are the elements that make up perceptions of outdoor spaces. They are both part of the physical environment and the perception of the individual relative to the behaviors that can be accommodated. In parks, affordances become part of behavior settings that are made up of the combination of the park users, the physical elements, and the behaviors that result from the interaction. In the design of parks and playground environments, behavior settings and affordances can become the framework within which similarities and differences in the environments can be analyzed (Moore & Cosco, 2007).

From a more visual perspective, Kaplan discusses environmental perception as a melding of views and information derived from the views. Environmental perception is discussed as information management which is set into a visual framework rather than the more cognitive framework established by Gibson. The commonality between them is the emphasis on the meanings elements have and their contribution to the makeup of places. Kaplan discusses views and vistas that are perceived as visual scenes that include the cognitive participation of personal interpretations that engage the mind (Kaplan, et al., 1998).

While there are similarities and differences in these approaches, their common significance is the recognition of an importance of the perceiver or top-down cognitive elements in human visual perception and its intersection with the physical environment. In application to visual research, they both apply meaning to visual sensation which must become a critical element of the research measurement.

2.2.7 Measurement Methods

Research of physical activity in the built environment has relied on three categories of measurement - inventory, observation, and survey, which contribute to the body of knowledge from different perspectives. Inventory information available in GIS databases can be used to provide a measurement of the physical and demographic environment for evaluating the research setting. Systematic observations seek to quantify revealed preferences of behaviors and attributes of users in the built environment (McKenzie, et al., 2006). Surveys seek to establish measures of personal habits, physical activity levels, and socioeconomic data, as well as expressed preference of attitudes, perception, and satisfaction of the users (Brownson, et al., 2009). This dissertation research is fundamentally based on direct observation methods rather than survey methods. As a result, direct observation methods will be the focus of this review.

Thirty-six studies were evaluated for their measurement methodologies and tabulated in APPENDIX TWO. Of these, there were twenty-eight studies showing numbers of facilities (parks or schools) having a range from a low of 1 facility to a high of 100 facilities and a mean of 14 facilities. Seventeen studies used fewer than 10 facilities and twelve of these studies used fewer than 5 facilities. The studies commonly include a background inventory in support of the main study focus.

Direct Observation Systems

Direct observation methods are used to gain an understanding of activities people participate in, the levels of physical activity they engage in, and the places and affordances these behaviors occur in association with (Kaczynski & Henderson, 2008). A benefit of direct observation is that it is gathering revealed preference data through observation of participants' behaviors. In surveys, the respondents' answers to the questionnaire items often don't match

their behaviors (Renne & Bennett, 2010). Direct observation has the capacity to corroborate these stated preferences. One significant impediment to direct observation is the high cost in terms of time that it takes to make the observations and gather the data. The need for multiple study sites for increased statistical power also adds to the burden of cost (Brownson, et al., 2009).

There have been some observational systems developed that have found acceptance and are frequently referenced in behavioral observation of outdoor recreation environments such as parks and playgrounds. The System for Observing Play and Recreation in Communities (SOPARC) uses many of the previous activity codes being a refinement of the earlier measurement systems SOPLAY and BEACHES. The SOPARC measurement tool records demographics and levels of physical activity within different activity settings in public parks. It has been widely accepted and used in public park research (McKenzie, et al., 2006). As a precursor to the SOPARC tool, SOPLAY (System for Observing Play and Leisure Activity in Youth) has also been widely accepted to measure physical activity in children in the school playground environment (McKenzie, et al., 2000). An early measurement tool developed by the McKenzie team is the BEACHES instrument that has been the foundation for the instruments that followed. The study used direct observation to analyze behaviors of physical activity and other habits recorded along with demographic information for each of the children (McKenzie, et al., 1991).

The study using SOPLAY did observations on 20 school play yards, 10 of which had equipment renovations done and 10 of which had no intervention. Ten observations were made after hours per school for a total of 200 observations. Physical elements were systematically rated and physical activity of participants using SOPLAY reporting incidence of moderate to vigorous physical activity (MVPA) for adults, boys and girls. Negative binomial regressions

were reported for adults, girls and boys in the renovated and un-renovated conditions against the playground attributes. Total number of play features were significantly associated with utilization by adults, girls and boys in the clustered regression and by adults and girls in the combined negative binomial regression (Colabianchi, et al., 2011).

In a study of parks, 10 randomly chosen parks in Ghent, Belgium were matched with 10 parks in San Diego using SOPARC as the observational tool. In this study, parks were each observed in three days, 2 weekday and 1 weekend observation days, with four observations being carried out each day at 8 am, 12 pm, 3 pm, and 7 pm. Park size was positively associated with vigorous physical activity. The main effects were identified as the study site (Ghent/San Diego), walkability which was positively associated with the number of visitors and those observed walking, and income level which was reported to have no effect on the intensity of user activity (Van Dyck, et al., 2013).

The SOPLAY tool was used alone in another study that assessed physical activity at 13 schools in southern California. Within the schools were 137 different activity areas. Each school was visited on 5 different days and separate scans were done for each activity area before school, at lunch and at recess. The unit of analysis for the study was each scan. There were a total 2,349 scans done, 1,126 of the scans had no people in them so they were eliminated for a total of 1,223 scans used in the analysis. Descriptive statistics were reported for the mean proportion of children engaged in each level of activity observed before school, and during recess and lunch. Regression analysis was done finding that children engaged in higher levels of physical activity in areas that were unsupervised (McKenzie, et al., 2010).

In a study taking place in the childcare environment, two observers were engaged to create maps of the child behaviors identifying the location of the child within six play area types on the playground, and level of physical activity the child engaged in for each of the two centers.

Each observer created four maps at each center, during morning observations in play time by walking a specified route within the play area, recording where children were playing and their levels of physical activity. This resulted in 8 maps for each childcare center. These maps were compiled into two overall maps, one map per center, locating child observations coded to activity levels. Percentages of activity for each setting type was reported in tabular format and the level of physical activity was reported graphically as a percentage occurring on different surfacing types (Cosco, et al., 2010). This direct observation study synthesized a number of observation systems and was the only one reviewed that reported activity in graphic format on a plan of the play area.

A study using accelerometers evaluated physical activity as a result of an intervention that was a physical renovation of outdoor play areas in 26 schools, 15 of which received funding for renovations, 11 were used as controls. Physical activity was reported on the children at recess for the baseline, 6 month, and 12 month time periods. Regression analysis of both morning recess and lunch time recess showed nonsignificant positive effects of the intervention on physical activity levels (Ridgers, et al., 2010b).

The studies using the SOPARC measurement systems will likely have the greatest relevance to this research. They are the most applicable to measuring the differences in use levels at playgrounds having different physical characteristics in an effort to gauge popularity of a construction type. Each of the studies has a potential contribution whether it be in the size and type of facilities studied, the numbers of participants or statistical methods and reporting. A recently published comprehensive review of studies using SOPARC identified twenty-four studies contributing to 34 articles strengthening support for use of SOPARC as an investigative tool. The study also identifies the specific application of the protocol toward a specific physical

park element or affordance as a unique approach in the use of the protocol (Evenson, et al., 2016).

2.2.8 Pilot Study

In the spring of 2012, an informal user count study was conducted in the setting of this research to test the hypothesis that a playground built to the higher principles of Universal Design (UD) receives more use than playgrounds built to meet the ADA Accessible Design (AD) standards. A single city study setting presents some unique opportunities where a number of related variables such as demographics, maintenance, tree canopy, and amenities are at similar levels. All are in close proximity to each other, and playgrounds are built using similar equipment from the same manufacturer, all meeting playground safety and accessibility standards. The complete pilot study is presented in APPENDIX THREE in an article reproduced from the Council of Educators in Landscape Architecture (CELA) journal, *Landscape Research Record* (Hurst & Lee, 2014).

A non-random visual count of the users of the playgrounds was undertaken at each of the seven parks in the city having playgrounds. The playground facility using UD principles at Coffee Park had a child per play event ratio of 1.06 and was found to have well over three times the children per play event as the mean of the comparisons (0.29). The a posteriori power analysis of the pilot study data with an alpha of 0.05 using STATA version 12. The analysis returned statistical power of 0.9734 where a power of 0.80 is considered a large effect (Acock, 2012).

Analysis of the observation data using descriptive statistics and power analysis appear to offer some initial support for the hypothesis that playgrounds built to UD standards, are used more frequently than playgrounds build using AD standards. This support comes with the

limitations of the small pilot study. Demographics and environmental variables that could reasonably influence use should become part of an overall analysis of user preference but were not included in the pilot study. The inclusion of the variables in this proposed dissertation study will help examine the study hypotheses with increased confidence.

2.3 Knowledge Gap

Theory presented in the literature has supported the value of UD in play environments as having the potential to encourage more use by people of all abilities benefiting adults and children alike (Goltsman, 2011; Moore & Cosco, 2007), yet quantitative evidence supporting the theory remains underdeveloped. An accompanying gap in the literature is evidence evaluating use patterns of these UD play environments in comparison with other play environments built to more common statutory AD standards.

There is a growing body of evidence reflecting the role of public parks in facilitating active living and increased levels of physical activity toward reducing obesity in society. As this evidence becomes more visible, the contribution of public open space and amenities to public health and reduction in the costs of public health is coming into focus (Mowen, 2010). The existing research is largely done at the scale of the park as a whole. There is little research that has examined the contribution of specific amenities to public park use or promotion of physical activity (Kaczynski & Henderson, 2008). Along with this lack of research is a reciprocal lack of research using direct observation and detailed park evaluations to investigate associations between amenities, and use, and physical activity (Colabianchi, et al., 2011).

Systems such as SOPARC have been widely used and accepted using systems of checklists based on target areas. As a result, these systems do not record specifics of where the participants, including children, are playing or what activity they are engaged in other than the

zone they are recorded in (McKenzie, et al., 2006). Locating subjects by target area locations are made using tally sheets identifying the subject's age, race, gender, and physical activity level without recording specifically where a subject is and their association with the physical amenities of the park. Observation research spatially locating users has been limited and there is an opportunity to apply the SOPARC protocols using both traditional map-based graphic recording and to some of the new GIS tools that are now available. There is a need for research being done using comparative methods evaluating use relative to specific amenities and the presence versus the absence of a particular park amenity (Cosco, et al., 2010; Moore & Cosco, 2007).

3. RESEARCH FRAMEWORK

A theoretical foundation will be applied to a practical research problem in an effort to contribute to evidence-based design in the use of a discreet element of public parks - children's play environments. Within the play environment, the quality of Universal Design (UD) meant to improve the user experience for children with disabilities will be evaluated for people of all abilities. The theoretical and practical framework for the evaluation is outlined in this section.

3.1 Theoretical Background

Evaluating the use of play environments and hypothesizing causal relationships has its basis in the application and synthesis of some foundational behavioral theories. Theoretical underpinnings of this research come recognizing the contribution of six primary models and bodies of theory into a theoretical whole. The basis and foundation are derived from the Social Ecological Model that leads to Active Living that identifies physical activity typologies. Behavior Setting Theory grows from this foundation to describe places of behavior from which Affordance Theory specifies physical elements that make up places where activity is conducted. The Accessibility Framework further specifies physical elements, and finally, Preference theory is used in the measurement of how the environment is used and the resultant contribution to physical activity behaviors. The benefit of a multifaceted approach can be to meld the salient contributions of multiple theoretical perspectives into a defensible evaluation of the contribution specific elements of play environments make to physical activity and health.

3.1.1 Social Ecological Model

There is a dynamic interplay between a diversity of environmental and personal circumstances leading to various conditions associated with human health and health promotion in a multidimensional construct termed the social ecological model. At its foundation, the social ecological model adopts the term 'ecology' that has been widely used to describe interrelations between living things and their living environments. In the human realm, this establishes a framework for evaluating people's behaviors and their surroundings, whether physical or sociocultural (McLeroy, et al., 1988; Stokols, 1992).

Social ecological models were established to integrate a dynamic range of influencers at multiple levels when evaluating human behavior patterns. The model evaluates physical activity as a distinct behavior pattern from the five perspectives of intrapersonal, interpersonal, organizational, physical, and policy. These models seek to address and evaluate the interactions of physical and sociocultural environments and their impact on the human users. In the study of health issues such as physical activity, ecological models are especially well suited because of the specificity of place where physical activity occurs and the diversity of other dimensions within which it is influenced. There is an identified need in the literature of developing a more environmentally specific version of the social ecological model that looks at characteristics of place which encourage or hinder physical activity. This body of theory reflected by the model would be useful in framing evaluation of various elements of environmental design and the ways they influence different behaviors (Sallis, et al., 2006).

3.1.2 Active Living

The widely recognized progression in society to inactive lifestyles has caused a worldwide health challenge that is moving toward critical magnitudes for people of all ages in

every nation. As a solution, interventions that have lasting effects are needed, the best of which will be multidimensional in scope. Efforts began in the 1970s with basic exercise guidelines recommending 20 minutes of vigorous exercise at least three times a week. This evolved into a recognition of the advantages of physical activity and public health based guidelines promoting the benefits of moderate physical activity from a health perspective (Sallis, et al., 2006).

The active living concept grew in the context of physical activity applying principles cultivated from ecological models. This ecological construct of physical activity has derived functional domains for the purposes of recreation, occupation, transport, and household. These domains advanced into the broader model of active living from simple physical activity and exercise. It is widely understood that a combination of these are correlates of physical activity in both the psychosocial context and the built environment. An understanding of the complexities of the relationships has the potential of supporting interventions having a meaningful impact on physical activity and health (Ding, et al., 2012).

An example of operationalizing active living in the built environment comes from a recent study of people moving to a neighborhood with high walkability characteristics. The study showed an increase in physical activity in people moving in from generally less walkable neighborhoods to the more walkable subject neighborhood (Zhu, et al., 2014). Continued research identifying findings that can inform environmental design of recreational and other facilities toward achieving meaningful interventions impacting active living behavior patterns have the potential to meaningfully affect human health (Sallis, et al., 2006). The recreation domain is the framework within which the behavior settings of the play environments in this research exist.

3.1.3 Behavior Setting Theory

Behavior setting theory was introduced in the 1960s by Roger Barker as a way to describe a small scale social setting located within the boundaries of space and time. The behavior setting is a system of elements to carry out a sequence of events in a system of small-scale social and physical environments. These systems have been applied to research in a variety of social, community, and school settings (Georgiou, 1996). More specifically, behavior setting theory combines both physical and social elements of the environment into a single unit that influences human behavior. Characteristics of a behavior setting as defined by the theory include both the physical elements of time, space, and objects, complemented by the social elements of specific normative behavior patterns. The technical explanation of behavior setting requires both the physical and the social constructs in its definition (Scott, 2005).

Application of the theory permits analysis of use to be differentiated more specifically than just by a geographic Zone. The settings can be conceptualized around physical elements and the spaces around them where they exert direct influence on behavior. Analysis at this level provides an opportunity to measure environmental behavior centered on use patterns promoted by the physical environment. The product of the analysis of use by behavior settings can quantify and give evidence in support of physical design characteristics that promote the desired set of outcomes (Moore & Cosco, 2007).

3.1.4 Affordance Theory

An important dimension of active living in the physical environment involves facilitating activity in recreational behavior settings through physical amenities referred to as affordances in the built environment. The concept of affordance has been used in the children's environment to identify physical elements whose perceived qualities attract, stimulate, and

afford a variety of activities (Cosco, et al., 2010). Other examples of affordances are benches creating a place to sit, a roof giving shelter, and a fire providing warmth but also the danger of being burned (Gibson, 1979). These affordances are the elements that make up perceptions of outdoor spaces and behavior settings. They have been shown to be what people think of as the framework of outdoor space and the subject of measurement.

Research involving the affordances themselves showed some positive association with improvements in park facilities. Elements that showed positively improved perceptions were the condition of trails, cleanliness, availability of picnic facilities, quality of the creek/lake, and variety of amenities. These studies focused on perceptions of people and children in outdoor recreation environments that found perception of the environment expressed in terms of affordances. These affordances are top-down in nature where the perceiver (child or adult) filters perceptual input based on its meaning or the behaviors an affordance supports (Mowen, et al., 2013). The connection between perception and meaning in recreational settings is key to understanding how they function and why they are used. This research seeks to evaluate affordances being physical elements, or a category of physical elements in the outdoor recreation and park environment, and their effects on behavior in general and specifically toward physical activity.

3.1.5 Accessibility Framework

The 2010 ADA Standards for Accessible Design were written and adopted in response to the need for inclusion and to establish a baseline minimum to meet that need. The principle of Universal Design (UD) in play goes beyond the minimum requirements of the 2010 ADA Standards seeking to design environments that are usable for all people, of all abilities, without the need for adaption to the greatest degree possible. Integration of UD brings value to people of

all abilities and ages linking children with peers and parents with parents in a recreational setting. The resulting UD environment has the potential to encourage more use by people of all abilities benefiting adults and children alike (Goltsman, 2011; Moore & Cosco, 2007).

The concept of UD has been defined in broad terms by at least two major university-based organizations, the Center for Inclusive Design and Environmental Access (IDeA) at State University of New York at Buffalo (www.ap.buffalo.edu/IDEA) (Knecht, 2004), and the Center for Universal Design at North Carolina State University (www.design.ncsu.edu/cud). The definitions are similar, with a common thread that is intentionally left open-ended to allow for design to serve a diversity of needs. North Carolina State defines UD as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaption or specialized design" (Story, 2011).

In play environments, going beyond the minimum Accessible Design (AD) standards includes making all or nearly all play features accessible, providing ramps to the majority of play features, and using highly accessible unitary surfacing on the ground level. In playgrounds, UD can make all play elements accessible to children and people of all abilities in an environment that offers play opportunities for everyone. The inclusive environment also seeks to include parents and caregivers who have physical disabilities (Goltsman, 2011). Anecdotal professional experience and the pilot study suggest that UD also has a positive influence on overall playground use by people of all abilities (Hurst & Lee, 2014).

3.1.6 Preference

The origin of preference theory comes from the late 1930s in economic utility theory attempting to evaluate what individuals were willing to pay for services. The format originated with work in revealed preferences of 'what is' or the value that individuals had demonstrated

they would pay. This evolved into economists desire to know contingent valuation based on stated preferences of surveys that asked a variety of questions involving 'what if'. Revealed and stated preference application has evolved over the last 60 years to go beyond basic economics including agriculture and behavior (Gordon, 2013).

Revealed preference approaches in recreation include evaluating the number of trips taken and numbers of people involved. A critical assumption is that the choice an individual makes has been influenced by the measured environmental qualities. Weaknesses of the revealed preference approach include misestimating the influence of environmental variables in revealed preferences and misinterpreting reasons for the behaviors. Stated preference methodologies can present hypothetical constructs to respondents through surveys where their responses state a perceived value of the construct. These survey responses have the potential of predicting or estimating outcomes to a variety of hypothetical possibilities (Whitehead, et al., 2000). The weakness of the stated preference approach includes discrepancies between survey responses and actual behavior. The literature has shown a common inconsistency between stated preferences and revealed preferences (Simoes, et al., 2013).

Systematic observation using momentary time sampling methodologies has gained acceptance in assessing use representing revealed preferences in the environmental context of public parks. The System for Observing Play and Recreation in Communities (SOPARC) has grown in an evolution of momentary time sampling methodologies developed for use in public open space (Evenson, et al., 2016; McKenzie, et al., 2006). This revealed preference methodology will form the basis of the observational research of this study.

3.2 Theoretical Framework

The Theoretical Model was developed with the application of six multidimensional elements of the theoretical background. From each of them, the thread of theory progresses from the more general and global theoretical models to the more focused and specific. A single domain will be applied to the Theoretical Model of this research from each of the models contributing to the primary aim, the hypothesis of the attractiveness of UD in playgrounds, and the secondary exploratory aims. The Theoretical Model is shown in Figure 3.1.

The framework of the Theoretical Model comes from the Social Ecological Model proposed by McLeroy which largely focused on the social context of behavior and behavior modification with a diversity of influences (McLeroy, et al., 1988). Evolution of this ecological model forms the foundation of the Active Living Theory that has a focus on four domains of daily behaviors that can include sedentary or active behaviors. The Active Living Theory specifies influences of recreational activities in the physical and social environment particularly those affecting or potentially affecting physical activity (Sallis, et al., 2006).

From the physical side of the active living domain of recreation comes the theories of Behavior Settings and their influences of places where behaviors happen, again including both social and physical dimensions, yet having a focus on the physical environment and the attributes of which it is composed (Barker, 1979; Scott, 2005). These physical attributes that make up behavior settings are composed of the complementary elements of Affordance which gives meaning to the behaviors that given physical elements can afford the user of the park and playground environment (Moore & Cosco, 2007). The theoretical thread continues its path from the general to the specific ending in the application of specific theory from a specialized class of physical elements in the Accessibility Framework.

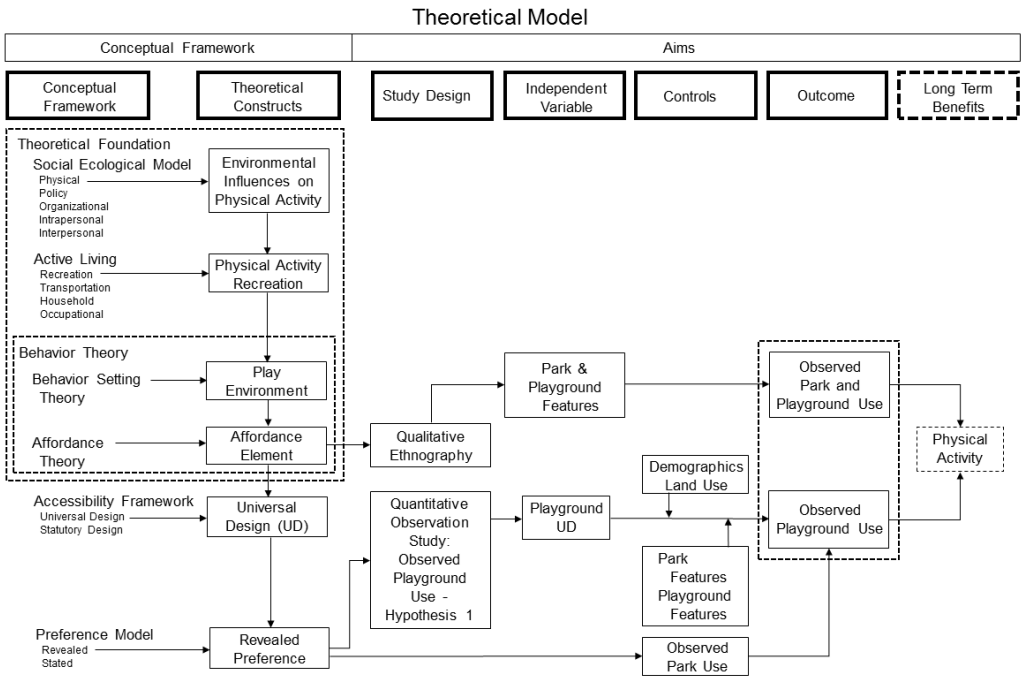


Figure 3.1: Theoretical Model

The primary aim of this research focuses on UD as a single design dimension of the built play environment and its influence on the population of playground users. This single physical element of the playground environment is of a very discreet physical nature taken from the Accessibility Framework. The domain of UD is manifest in part by the physical form of equipment used on the playground and the way in which elements are assembled and accessed, having the goal of being usable by all without adaption. The domain of UD comes from and is a part of the larger physical domain Affordance Element from the body of Affordance Theory which is itself a component of the Play Environment domain of Behavior Setting Theory. The need for evaluation of different types of physical elements in outdoor spaces is identified as a common theme in the literature (Koohsari, et al., 2015).

These physical domains combine with the theoretical foundation of the Social Ecological Model reflecting its physical domains leading into the physical activity typologies in Active Living. The Social Ecological Model provides the overriding body of theory from which the Active Living domains have arisen. In this research the focus is on leisure activity, as a result, the recreation domain in Active Living will be most applicable. These domains form the theoretical foundation that is the basis of the most tangible construct of the hypothesis. The hypothesis will be examined using observational data consistent with the established SOPARC protocol evaluating Revealed Preferences (McKenzie, et al., 2006).

The secondary exploratory aims incorporate all of the theoretical elements of the primary aim with the exception of their not having a direct connection to UD. Qualitative research has the ability to examine relationships between affordances or physical amenities, their use, and physical activity in the complexity of the public park environment and specific physical qualities of open spaces and behavior settings in an open-ended fashion without the limitations of a research question or hypothesis (Georgiou, et al., 1996; Koohsari, et al., 2015). The qualitative evaluation will be done with respect to user location and physical activity using direct observation recorded and analyzed applying behavior mapping techniques that were developed to evaluate people's interaction with the environment. Application of behavior mapping is demonstrating an ability to reveal use patterns in outdoor public spaces delivering evidence about the use of spaces and physical activity that can be applied to the evidence-based design process (Refshauge, et al., 2013).

3.3 Practice and Policy Framework

The central practice driven component of this research is the issue of accessibility in children's play environments. The literature review has expressed the value, purpose, and need

for accessibility, which is operationalized at the minimum level by meeting the statutory requirements of the 2010 ADA Standards for Accessible Design. This basic level will be referred to as Accessible Design (AD). The literature reveals many populations of people with disabilities for which ADA was written who have needs that go beyond the basic levels of ADA in a variety of directions which brings up the value of special design consideration to tailor a play environment for a specific population.

With AD representing the minimum standards, the user populations often have the need to raise the levels of accessibility provided in play environments. The expressed purpose of UD is to give guidance to practice by advocating making play environments accessible to children and people of all abilities in inclusive environments that offer play opportunities for everyone without the need for adaption. This is done by providing an accessible route to play elements and through creative design thinking (Goltsman, 2011). This definition and understanding is provided in a generalized conceptual format, without specificity, so that it can be responsive to the many special and unique needs of people having disabilities. In recognition of the value of this dynamic element in the definition of UD, the lack of specifics may be a little vague to define UD for use in this behavioral research.

3.3.1 Operational Definition of Universal Design

For the purposes of this research, quantitative operational guidance toward a definition of UD will be put forth as an assumption, but may not fully address all of the dynamics represented by UD. The ADA standards statutorily define accessibility primarily in terms of the accessible route, numbers of elevated play events on the accessible route, and numbers and types of ground level play events. These three primary elements are defined in quantitative terms as minimum requirements in the standards, the operational use of UD used in this research will be

to double the statutory quantitative definition of each of these three elements. Review of the literature and correspondence with the IDeA Center at University of Buffalo, State University of New York has revealed little work done to date in quantifying specific guidelines for identifying UD in the play environment (APPENDIX FOUR, Maisel, 2016). The intent of this operational definition is to propose an assumption that will assist in quantifying a differentiation between the Case and Comparison playgrounds in measurable terms.

Beginning with the definition of accessible routes, the standard says that 50% of the elevated play events need to be on the accessible route (U.S. DOJ, 2010). It also discusses the composition of the accessible route in regard for the need of a resilient surface to attenuate falls as allowing for both unitary resilient surfaces and loose fill resilient surfaces. This operational definition of UD will adopt the need for unitary resilient surfaces that are easier for people using mobility devices to use, and that 100% of the elevated play components be on the accessible route.

The definition of 50% of elevated components being on the accessible route includes the surfacing and extends to the construction of the elevated components themselves. There are two classes of accessibility to the elevated components, the first of which is transfer accessibility allowing a user to transfer from a mobility device onto elevated components then crawl or climb to the elevated events. The second class is ramp accessibility, which is not statutorily required until the number of elevated play events exceeds 19 and then only half of the 50% accessible route requirement or 25% is specified (U.S. DOJ, 2010). In this operational definition, once again, 100% of the elevated components need to be on the accessible route with a minimum of 50% of those components being ramp accessible. In order to be considered on an accessible route, the remaining 50% of the elevated components must be transfer accessible either from the ground or from the elevated platforms.

Ground level play events and accessibility to them are required by ADA to provide opportunities for play and interaction with peers to those children who are not capable of accessing elevated equipment. Ground level play events are also defined by the type of activity the event supports such as swinging, rocking, spinning, and others (U.S. DOJ, 2010). Minimum numbers of events and minimum numbers of types of events on the ground level are defined in proportion to the number of elevated play events (U.S. DOJ, 2010). For the operational definition, the minimum number of ground level events and the number of types of events will be twice those defined in ADA and all of them will need to be on the accessible route.

In summary, the operational definition of UD for the purposes of this dissertation research will be that the accessible route will be entirely composed of accessible unitary surfacing, 100% of the elevated and ground level components will be on the accessible route, at least 50% of the elevated components will be ramp accessible with the remaining components being transfer accessible from either the ground or the elevated platforms, and the quantity of ground level components will be twice the required number of both quantity and type.

4. AIMS AND HYPOTHESIS

This research seeks to evaluate the influence physical design has in the playground environment on the use of the facilities. It will look primarily at the influence of UD in the playground within the context of the overall park environment. Secondary effects will be evaluated in terms of the use of other park and playground amenities and their contribution to physical activity.

4.1 Primary Aim

Compare the association between the applications of Universal Design (UD) principles in playground design with levels of use in comparative playground environments applying UD in comparison with those using Accessible Design (AD) standards. Conduct an observation study in a suburban setting with a case applying UD and two comparison parks using AD with established protocols, graphically recording users in park and playground settings evaluating revealed preferences expressed by use with a focus on the physical elements of accessible design in playgrounds represented by UD versus AD.

Hypothesis: *Playgrounds designed to the higher standard of UD, will be used more by people of all abilities versus playgrounds designed using AD standards.* Conduct participant observations graphically recording people present and their attributes of gender, age, and physical activity. The primary analysis will be to compare overall use levels between the playground environments applying UD and those applying AD standards. The analysis will be done on both effect size using descriptive statistics and on significance using ANOVA and regression analysis. Secondary effects will include assessment of relationships found involving gender, age, and physical activity levels.

4.2 Secondary Aims

Use of Affordances: *Conduct exploratory behavior mapping research in the Case and two Comparison parks evaluating where the use is taking place in the park and play environments relative to specific physical elements.* Recording of participants will be done graphically on plans of the park and playground sites plotting the subject's gender, age, and physical activity levels. Qualitative relationships will be evaluated looking for patterns of use in relation to park and playground environment physical features, or affordances, which support different activities. Use levels expressed through descriptive statistics can become indicators of the attractiveness of affordances in and between behavior settings (Moore & Cosco, 2007).

Physical Activity: *Conduct exploratory research on the physical activity in park and playground areas, evaluating the effects that park and playground physical features, or affordances, including UD in the play environment, may have on physical activity in public parks.* Environmental effects on physical activity levels, Active versus Sedentary, will be evaluated in terms of their percent of the total for each age division. These physical activity levels will be analyzed using descriptive statistics of the numbers of users by affordance setting and age group. The data will be analyzed in terms of total and average metabolic equivalent (MET) scores of the recorded physical activity categories (VanDyck, et al., 2013; Cohen, et al., 2007). These will be applied to the parks as a whole and to the playgrounds and their included affordances.

This research is being done to make a contribution to evidence-based design in public open space by showing the benefits that UD offers to the general public. The anticipated benefits of increased park use and increased physical activity are anticipated to give evidence supporting the use of UD in more playgrounds. Encouragement of UD for the general public will also promote inclusion and benefit the population of people with disabilities by illustrating a

universal value of facilities designed to meet the access and functional needs of everyone, with the accompanying benefit of more use of the outdoor built environment, getting everyone outdoors and more active, independent of physical ability.

5. METHODS

Observations of park users were done in the park and playground environments of three city parks in a single community setting where many important park variables were held at a similar level. Established protocols were taken from the literature and adapted applying a graphic format that recorded the park and playground users along with 16 levels of the variables age, gender, and physical activity in their observed location at the time of observation.

5.1 Research Design

The research is a cross-section case study investigating the level and use of a play environment built using Universal Design (UD) principles compared with those meeting Accessible Design (AD) standards employing minimum ADA requirements. It begins with a background inventory review of neighborhood and site-specific factors, then focuses on a protocol of direct observation of participants recorded graphically on the site. Participants are recorded through observations using an adaptation of established protocols graphically recording users across the entire park where they are recreating in both the park and playground areas.

5.1.1 Research Setting

The research setting will be in the suburban north Dallas City of University Park. The City is largely a bedroom community of approximately 3.8 square miles, located about 5 miles north of downtown Dallas having a stable population of approximately 23,000 residents. It was founded in 1915 and incorporated in 1924 being built around a major private university. The research will employ three sites, focusing on the playground environments at Roy Coffee Park as the "Case" and Caruth Park and Curtis Park as the "Comparisons" shown in Figure 5.1. The

City and its parks were chosen for the parks being in close proximity to one another and having a comparable demographic, with similar park qualities such as being well maintained and having old growth trees to create a shady, attractive park environment in all of the study parks (University Park, 2016).

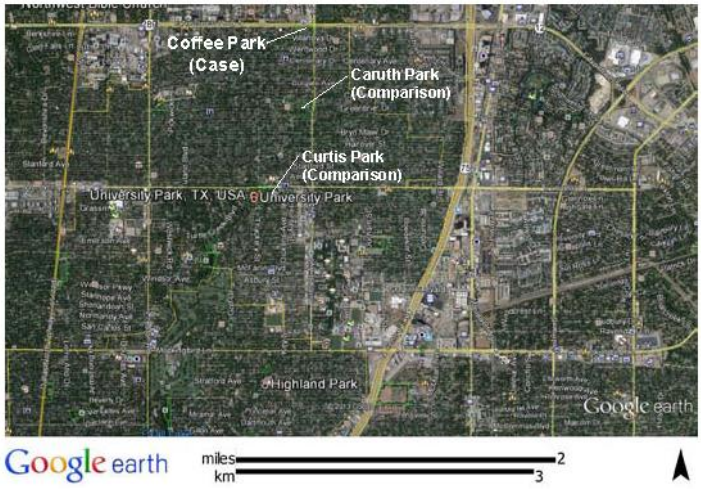


Figure 5.1: City of University Park Study Parks, Case and Comparisons

The parks themselves were chosen for their similarity of character and use, being all neighborhood parks of moderate size with comparable facilities and use patterns, and being close enough to one another to have the study observations done within the timeframe of about an hour. The playgrounds themselves are comparable in size and character, being the three busiest parks from the pilot study. The difference is the Case playground is designed using UD principles, where the Comparisons are designed using AD standards. The similarity of character in the overall parks and City environs is supportive of the assumption that many of the moderator variables involving city and park planning, which could reasonably influence the outcome, are

controlled at similar levels (Hurst & Lee, 2014). This assumption will be analyzed in the Results.

Coffee Park, the Case, is the furthest north of the three parks and was the subject of a renovation project in 2009 completely replacing the existing playground with the expressed purpose of building a neighborhood play environment that is inclusive being built applying UD principles. Anecdotally, use of the existing playground was not unusually high before the renovation. After renovation, use understandably saw a tremendous increase. Three years after the renovation the 2012 Pilot study recorded a substantial differential in use between the playground at Coffee Park and six other playgrounds in the system (Hurst & Lee, 2014). A ground level photograph of the park and aerial photo from Google Earth are shown in Figure 5.2.

Figure 5.2: Research Setting: Coffee Park, Case

The two Comparisons, Caruth Park and Curtis Park, are also neighborhood parks of similar character and somewhat larger than Coffee Park. Similar facilities of tree cover, trails, and sports fields can be seen in all three of the parks. Some differences that would tend to weigh

in favor of the Comparisons are the existence of tennis courts and a water feature or pond. The Comparisons are shown in Figures 5.3 and 5.4. Curtis Park also has a public swimming pool for use by the City residents in the summer months. The pool is fenced and was not yet opened or operating in any way during the days of the observations.

Figure 5.3: Research Setting: Caruth Park, Comparison

Recently, each of the Comparison playgrounds underwent upgrading renovations that replaced the loose fill playground surfacing that was in use during the pilot study with a unitary poured in place surface matching that at Coffee Park. They were also fitted with integrated shade structures matching that of Coffee Park as well. These renovations took the next step in making many of the physical elements of the play environment very similar to those at Coffee Park with the exception of the quality of UD.

Figure 5.4: Research Setting: Curtis Park, Comparison

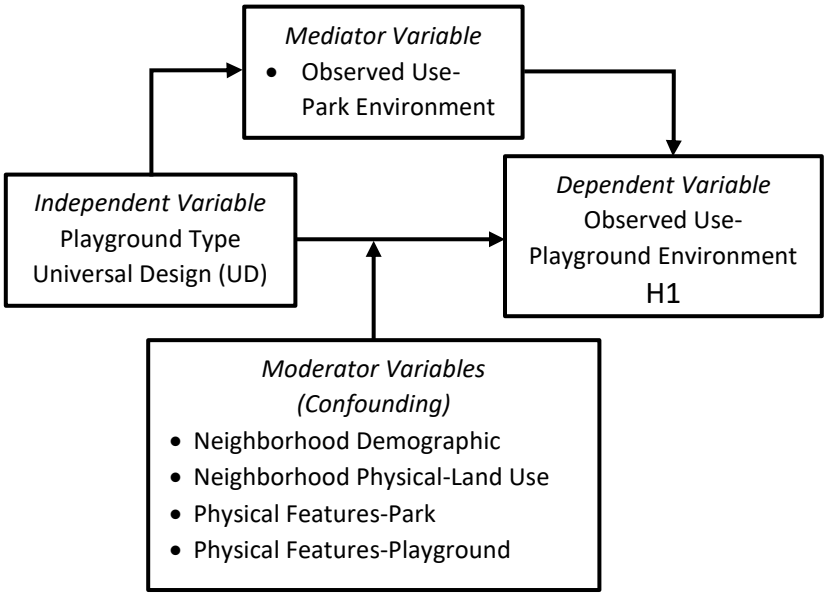
The setting is unique in providing similar qualities of both the immediate setting and surrounding neighborhoods and demographics. It gives an opportunity for comparative case study research evaluating the differences of use between physical qualities in an environment where many of the potential confounding elements can be considered controlled. The demographic and physical variables and evaluation of their potential confounding effects will be further detailed as part of this research.

5.1.2 Measurement Models

The direct observation data will be subject to two separate research models relative to the primary research aim and hypothesis testing, and the secondary exploratory aims. In the primary model, the mediator and moderator variables will be evaluated for their influence along with the independent variable. The secondary exploratory model will be evaluated without hypotheses, looking without premise for relationships that may surface unanticipated.

Primary Aim Measurement Model

In in the Primary Aim, the independent variable is the playground design type, either being designed using UD principles or AD standards. It is hypothesized to be the primary contributor to increased attractiveness expressed by higher levels of use in the case playground and is the subject of this research. The measurement model showing the relationships between the independent variable, the mediator and moderator variables, and the dependent variable, is shown in Figure 5.5.



H1: Playgrounds designed to the higher standard of UD, will be used more by people of all abilities versus playgrounds designed using AD standards.

Figure 5.5: Primary Measurement Model

The independent variable, Playground Type, has a binary expression of UD in the "Case" and AD in the "Comparisons". The dependent variable of Observed Use in the

Playground Environment will be measured using direct observation techniques applying protocols developed in the System for Observing Play and Recreation in Communities (SOPARC) (McKenzie, et al., 2006; Cohen, et al., 2007; Van Dyck, et al., 2013). The focus of the data measurement and analysis will be of total use in the playground environment. Data will be recorded on components of the dependent variable for qualitative analysis. Gender, age groupings, ability, physical activity levels, and participant location will be recorded graphically. Literature has shown that dogs can be an indicator of moderate physical activity, dogs will be recorded for qualitative purposes (Lee & Moudon, 2008). Variables and their Domains are shown in Table 5.1.

The independent variable of Playground Type acts on the dependent variable with potential influence from the mediators and moderators. The park will be divided into target areas in accordance with SOPARC for the purpose of recording use in different park sectors including the playground environs. The mediator variable of Observed Use in the Park Environment outside the play areas is expected to be similar between the parks and will be measured to evaluate and confirm the assumption of being controlled.

Moderator variables are divided into neighborhood and physical factors including neighborhood demographics, neighborhood land use, and physical features of the park and playground that have been measured as a part of the research proposal and site selection. As a result of the selection of the city of the study setting and the three parks, these variables are considered to be held at similar levels or at levels that do not appear advantageous to the Case playground and are therefore assumed to be controlled. They are measured and analyzed to evaluate and confirm support for the assumption of control.

Table 5.1: Primary Aim Variables

	Domains	Variables	Measures
Independent Variable	Accessibility	Playground Type	Universal Design (UD) versus Accessible Design (AD)
Dependent Variable	Playground Use	Number of users observed in Playground Environment	Observed number of people using the play environment. By age (0-4, 5-12, 13-19, >20), gender (male/female), ability, physical activity level (sedentary, moderate-vigorous), Presence of Dogs
Mediator Variable	Park Use	Number of users observed the in Park Environment	Observed number of people using the park environment. Children/Adults
Moderator Variables	Regional Factors	Neighborhood Demographics	Age grouping: 0-9, 10-19, >20
(Confounding)	Physical Factors	Neighborhood Physical Physical Features -Park Physical Features -Playground	Percent Land Use Type Park and Playground, Active and Passive Use Affordances and Accommodations (each or unit of measure)

The dependent variables, including gender, age, physical activity and user location will be measured and recorded graphically on a plan of the site using behavior mapping techniques (Moore & Cosco, 2007; Cosco, et al., 2010). Gender will be recorded as male/female for all age groups, ages will be recorded as preschool (0-4), school age (5-12), teen (13-19), and adult (20+). These age groups are consolidated into Child (0-12) and NonChild (13+) for data analysis. This age grouping will be subject to the field judgment of the researcher as the subjects will not be contacted in accordance with IRB approvals. Child age groupings are selected based on industry practice and are consistent with the previously referenced playground safety standards in CPSC and ASTM. The groupings are a slight mismatching of the age groupings given by Esri (child 0-9). This mismatch should not be critical because children around 10 years of age begin the Concrete Operational Stage of development and are showing less interest in

stationary playground equipment and more interest in games with rules, then moving on to active sports (Thompson, 1992).

Levels of physical activity will be measured as sedentary (lying down, sitting, standing), and active (walking, running, jumping, climbing, sliding, swinging), then translated into metabolic equivalents or METs (McKenzie, et al., 2006; Cohen, et al., 2007, Van Dyck, et al., 2013). They are anticipated to be at higher levels in association with hypothesized higher use. Locations of the users at the time of recording are without hypothesis and will be treated qualitatively as an exploratory ethnography.

Secondary Aims Measurement Model

The secondary aims will make an exploratory evaluation of the data from the dimension of where the users are in the park with the locations being relative to significant affordances in the park. The literature has identified the need for more research evaluating the relationships between park amenities, use, and physical activity (Colabianchi, et al., 2011; Kaczynski & Henderson, 2008). The model shown in Figure 5.6 shows the conceptual links between the three constructs with affordance influencing use by location which in turn influences physical activity. The model will be analyzed using descriptive statistics in a qualitative evaluation looking for relationships that may surface with the new data. This exploratory evaluation can be used to draw some generalized ideas about park use and to be a catalyst for future research.

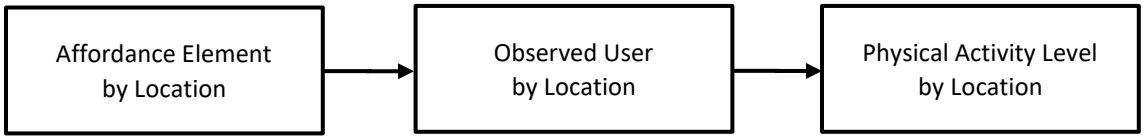


Figure 5.6: Secondary Aims Measurement Model

Affordances will be grouped by zone, divided into Park Zone Affordances and Playground Zone Affordance. Park Zone Affordances are active sports fields, park trails, gathering areas, and site furnishings. Playground Zone Affordances also include gathering areas and site furnishings, adding shelter, play structure, swings, and play surfacing. Results will be presented in both descriptive and graphic formats. Both the primary aims and the exploratory aims will draw from the same data that will be collected using the same observation protocols.

5.1.3 Background Inventory: Moderator Variables (Confounding)

The objective in undertaking the measurement of the existing features and environs of the park is to arrive at and document a defensible understanding of the physical conditions in the Case and Comparison parks. Characteristics of neighborhood demographics and land use have been measured using GIS and field confirmation. Park features have been inventoried on site using standard site analysis techniques. Inventory and evaluation of these variables are done to confirm the assumption that the stated moderator variables are reasonably similar or give little indication of advantage to the case playground and can be assumed to be controlled.

Neighborhood Demographics and Land Use

Neighborhood demographics and land use within the park service areas are measured using two intervals, ¼ mile, and ½ mile, representing the minimum, and moderate walking

distances that are considered within the influence area of a neighborhood park. The measurement intervals and land uses are shown in Figure 5.7. Demographic data including total population, median age, population by age, the number of housing units, race, and income have been inventoried within each distance interval from the Esri Business Analyst software package. Land use assessment was made using aerial photography provided by Google Earth and verified with ground observation. Tabulation of the measurements of demographics and land use at the ¼ mile and ½ mile intervals are shown in Table 5.2.

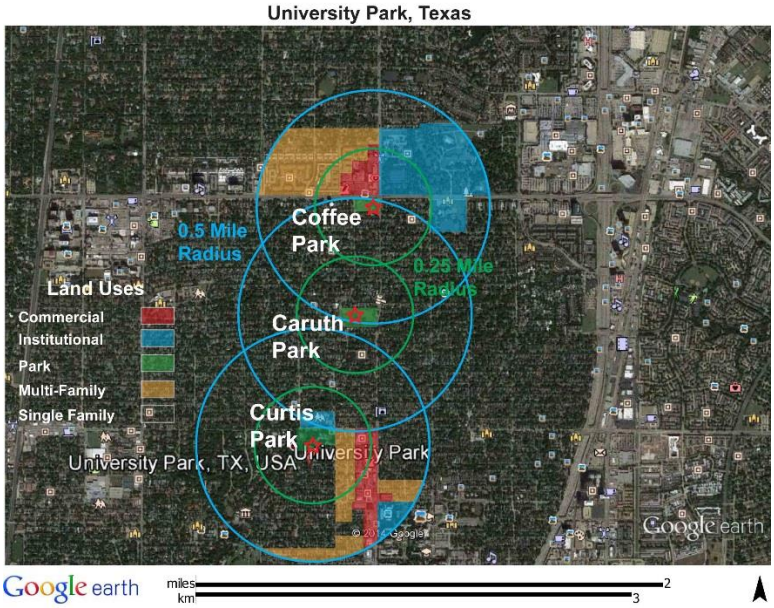


Figure 5.7: Park Area Land Use, ¼ Mile and ½ Mile Radius

The overall population of the three parks is very similar at both distance intervals, yet the numbers of children are considerably lower in the Case at both intervals. A total number of households is higher in the Case as is the median age. Median income is over 25% lower at both

distance intervals of the Case neighborhood and housing value is approximately 10% lower. Racially, the neighborhoods are all very similar being over 94% white.

Land use is divided into five general classifications consistent with planning practice. The categories are Commercial, including all business functions; Institutional, including school, university, church, and cemetery functions; Multi-Family, including multi-family dwellings and apartments; Single Family including homes; and Park which is the three parks in the study. Of the park service areas, Caruth Park has only Single Family housing as a land use in the ¼ mile service area and only small amounts of the other land uses on the edge of the ½ mile service area. Both Caruth Park and Coffee Park are within ½ mile of each other and are included in the corresponding ½ mile service areas of the other park. Curtis Park is slightly further than ½ mile from Caruth Park and has no other parks in its service areas. Coffee Park has the smallest Park allocation and the largest amounts of each of Commercial, Institutional and Multi-Family land uses.

Tabulation of land use shows higher levels of commercial and institutional land use in the Case neighborhood. With a higher median age, lower numbers of children, lower median income and home values, and lower numbers of single family residences in the Case, it would seem that these elements would have a more negative impact on park and playground use. With the result of the macro-scale demographics and land use variables showing no clear advantage to the Case, these variables are assumed to be controlled.

Table 5.2: Neighborhood Demographics and Land Use

	¼ Mile Area			½ Mile Area		
	Case	Comparisons		Case	Comparisons	
Variable	Coffee	Caruth	Curtis	Coffee	Caruth	Curtis
Demographics (estimated 2015)						
Total Population	1,276	1,199	1,335	4,559	5,240	5,318
Age 0-9 years	175	187	169	571	815	675
Age 10-19 years	188	255	225	649	1,113	1,020
Age 20+ years	911	758	941	3,340	3,311	3,622
Total Households	573	379	510	2,041	1,621	1,971
Median Income ($)	121,000	200,000	133,000	116,000	200,000	157,000
Median Home Value ($)	1,000,000	1,000,000	1,000,000	902,000	1,000,000	979,000
Percent White (%)	95.9	96.9	94.9	94.5	96.4	94.0
Median Age	45.1	40.9	36.8	46.3	40.9	35.3
Percent Land Use						
Park	3.6	5.4	7.5	1.7	2.1	1.8
Commercial	11.7	0	6.0	3.1	0.1	5.7
Institutional	17.4	0	4.5	18.4	0.8	2.9
Multi-Family Residential	9.0	0	12.0	13.6	0.1	8.7
Single Family Residential	58.3	94.6	70.0	63.2	98.7	80.9

Source: Esri Demographic and Income Comparison Profile, December 10, 2015.
US Census Bureau, Census 2010 Summary File 1. Esri forecasts for 2015 and 2020.

Physical Park and Playground Inventory

Aerial photography from Google Earth of the three parks shows Coffee Park, the Case, to be the smallest in acreage, have the lowest amount of tree canopy coverage for shade and is without a water feature. These variables are often considered to be attractive elements with respect to park use (Van Dyck, et al., 2013). Coffee Park has only 2 more parking spaces than does Caruth Park but has only about 2/3 the parking available to Curtis Park users. Total numbers of picnic tables, park benches, drinking fountains or toilets do not appear to give rationale to an advantage in the Case condition. These variables for both the park and playground environments are shown in Table 5.3.

Evaluation of the moderator variables (controls) in the play environments involved a review of aerial photography, installation records, and on-site observations. The independent

variable, Playground Type, is only expressed as UD in Coffee Park, the Case playground. Of the three play environments, the square footage of the play area surfacing at Coffee Park is between that of Curtis Park and Caruth Park, and the playground environment as a whole is the smallest at Coffee Park. The numbers of play events at Coffee and Caruth are similar at 40 and 41 respectively, but lower in Curtis having only 31. There is a shelter structure in the Case and not in the Comparisons but the numbers of picnic tables and park benches show little advantage to the Case. With the exception of numbers of play events, which will be adjusted in the analysis, the moderator variables do not appear to give an advantage to the Case playground and will be assumed to be controlled. Further analysis will be given to these variables in the data analysis.

Table 5.3: Physical Features: Playground and Park Inventory

	Playground			Park		
	Case	Comparisons		Case	Comparisons	
Variable	Coffee	Caruth	Curtis	Coffee	Caruth	Curtis
Universal Design (UD)	1	0	0			
Playground Surface s.f.	6400	7900	5700			
Playground Environment s.f.	18,800	23,800	31,800			
Play Events	40	41	31			
Shelter Structure	1	0	0			
Toilets	1	1	1	1	1	1
Drinking Fountains	1	0	1	2	2	3
Benches-TOTAL	5	15	5	5	5	12
Picnic Tables-TOTAL	6	6	3	0	1	8
Playground on Walking Trail	1	1	1			
Length of Walking Trail Circuit (ft.)				1440	1401	2084
Park Acreage				4.3	7.1	9.5
Tree Canopy Coverage (%)				34	36	44
Water Area (%)				0	13	12
Parking-TOTAL				46	44	72
Public Use Athletic Facilities				2	3	2

5.1.4 Study Area Terminology Conventions

For the purposes of this study, the parks and playground areas will be subdivided based on conventions outlined in the literature. In the SOPARC protocols, the parks and areas being studied have been divided into Target Areas (TAs). The TAs are areas where broadly similar use patterns are engaged in by the participants or subjects of the study (McKenzie, et al., 2006). These TAs will then be grouped into Park Zones and Playground Zones for evaluation of the aims and hypothesis as applied by Moore & Cosco. This grouping into Park Zones and Playground Zones will be kept throughout the study. It will shift to finer grained focus on affordances and behavior settings for more detailed evaluation in the qualitative analysis (Moore & Cosco, 2007). The Park Zones, Playground Zones, TAs, behavior settings, and affordance areas will be further detailed and specified in the following sections.

5.2 Measurement Methods

Observations were done using the protocols of SOPARC applied to a graphic format (McKenzie, et al., 2006). Observations were done on 14 days, 2 of each of the 7 days of the week at 5 times for each day. The days and park observation order were chosen randomly, four of the five time periods were taken from the literature with one added for this research.

5.2.1 Operationalizing Universal Design

An operational definition was put forward in Section 3.3 defining UD in terms of having all unitary surfacing, all elevated play events on the accessible route, 50% of them being ramp accessible, and having twice the numbers and types of ground level play events required by ADA. This definition essentially doubles the requirements of the 2010 ADA Standards and defines UD in clearly quantifiable terms. An analysis of the playgrounds at each of the study

parks is shown in Table 5.4. The table shows numbers of play events and ground level play events for each of the playgrounds divided by age group respective of the playground safety standards. The playground at Coffee Park shows an overall total because the two age groupings are joined by the ramp structure where the total is not applicable (NA) in Caruth Park or Curtis Park because the structures for the different age groupings are separated.

Table 5.4: Accessible Play Event Analysis

Park	Age Group	Total Elevated Events	Ramp Access	Transfer Access	Required* Ground Level Events No.*	Required* Ground Level Events Type*	Provided Ground Level Events No.	Provided Ground Level Events Type
Coffee Park	2-5	9	7	2	3	3	7	3
	5-12	14	7	7	5	3	10	7
	Total	23	14	9	8	4	17	8
Caruth Park	2-5	8	0	8	3	3	6	3
	5-12	18	0	18	6	3	9	4
	Total	NA						
Curtis Park	2-5	6	0	6	2	2	4	3
	5-12	12	0	12	4	3	9	4
	Total	NA						

* from Table 240.2.1.2, 2010 ADA Standards for Accessible Design

Unitary poured in place surfacing is used on all three of the playgrounds so the first element of the definition of UD is satisfied in all three cases and the surfacing type is a constant for other analyses. All of the playgrounds also meet the ADA requirements for ground level play events in both quantity and type and they each have all of their elevated play elements on an accessible route. Of the three, only Coffee Park has ramp access and it does meet the UD 50% ramp access definition for both 2-5 year old equipment and 5-12 year old equipment. The

playground at Coffee Park also has more than twice the ADA minimum numbers of ground level play events and the twice the number of types for the total and for 5-12 year olds alone although it only meets the minimum for 2-5 year olds alone. In light of the play structure linking 2-5 and 5-12 year old events by ramp, the more appropriate count is for the total.

In this analysis, all of the playgrounds meet the minimum ADA standards for elevated play events on the accessible route and for ground level play. With the playground at Coffee Park being ramp accessible at the level stated, and ground level events being twice the ADA minimums it meets the operational definition of UD put forth for the purposes of this research and it is the only one of the study playgrounds that does meet this definition. Therefore, this analysis would give support to the playground at Coffee Park being defined as UD and the playgrounds at Caruth Park and Curtis Park being defined as AD.

5.2.2 Observation Protocols

The outcome variable addressed in the hypothesis is the number of users observed in the playground area which is the focus of the data collection in observations. The three parks are divided into Park and Playground Zones for analysis. Along with total numbers of users, data will be collected on estimates of user gender, age category, ability, and physical activity level. In response to the homogeneity of the population (94.0% to 96.9% white in the areas surrounding the parks), and with no racial component in the hypotheses, data will not be collected on race. Users will be recorded graphically in the location they occupy. Analysis will then be possible based on a variety of criteria since the raw data shows the location and attributes of each individual recorded.

A momentary time sampling methodology was applied when conducting the observations using the protocols validated through the System for Observing Play and

Recreation in Communities (SOPARC). Observations of park users were carried out in Coffee Park, the Case, and in Caruth Park and Curtis Park, the Comparisons (McKenzie, et al., 2006). Observation days per park has varied in the SOPARC literature from three days (Van Dyck, et al., 2013) to seven days (Cohen, et al., 2007; McKenzie, et al., 2006). Four observations per day were used in the SOPARC validation study at 7:30 am, 12:30 pm, 3:30 pm, and 6:30 pm and were meant to measure use in the morning, noon lunch hour, afternoon, and evening (McKenzie, et al., 2006).

Trials done February 19th demonstrated that observations took about 10 minutes per park and they can be carried out in each of the three parks within approximately 30 minutes total. Observation period timing is at 7:30 am, 9:30 am, 12:30 pm, 3:30 pm, and 6:30 pm, using the same times as validated by SOPARC with the addition of an observation at 9:30 am to capture morning playground use. Consistent with SOPARC protocols, two rotations of observations are carried out during each time period, then the two observations are averaged for a single mean number of users reported for each time period.

The daily observations were done in 2 sets of 7 days, each set in a three week time period. In each set, one observation day on each day of the week was chosen randomly, resulting in a total of 14 observation days, with a total of 2 days observed for each day of the week, Sunday through Saturday. This will result in 70 observations (5 observations per day, 14 days) of the case park and 140 observations (5 observations per day, 14 days, 2 locations) of the comparison parks for a total of 210 observations.

In the literature, parks were divided into target areas to capture use in areas of the park that have different functional foci. Numbers of target areas in the literature ranged from a mean of 20 (Cohen, et al., 2007), to between 2 and 9 (Van Dyck, et al., 2013). Each of the study parks has a play area designed for 2-5 year olds, one designed for 5-12 year olds, swings, was

surrounded by associated playground gathering areas, two active sports fields/courts, and open park areas for inactive or passive use. The parks of this study are divided into 8 Target Areas (TAs) in each for the case and comparisons. Target areas each focus on different activity types, 4 in the Park Zones and 4 in the Playground Zones, as shown in Figures 5.8 & 5.9 (Curtis Park has a fee-based swimming pool that will be closed and will not be part of the study).

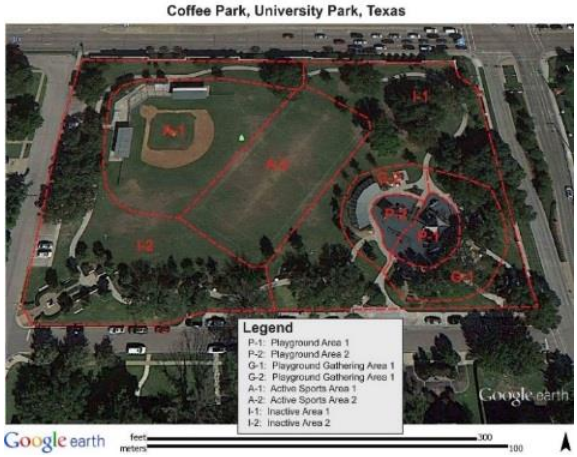


Figure 5.8: Target Areas-Coffee Park, Case

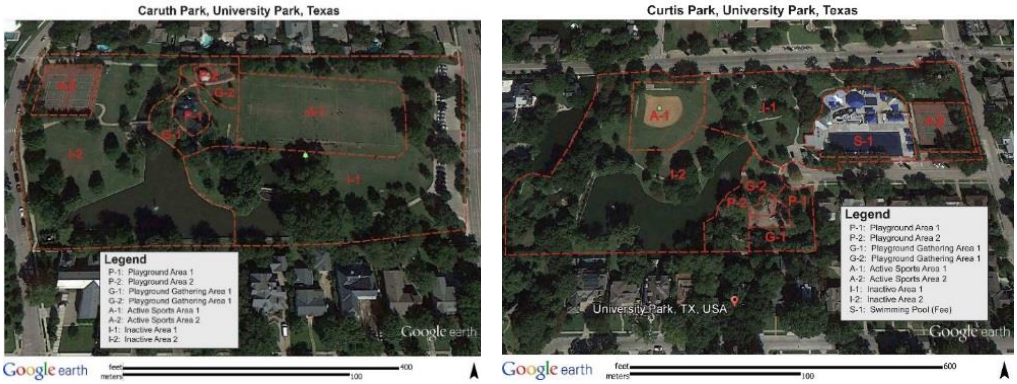


Figure 5.9: Target Areas-Caruth Park & Curtis Park, Comparisons

As shown in the figures, there are four TAs in the Playground Zones, two are active playground TAs, one focusing on activity for 2-5 year olds, and the other focusing on activity for 5-12 year olds with two accompanying inactive playground gathering area TAs. In the Park Zones, there are two active use TAs and two inactive use TAs. Observations will be made and recorded in the Playground Zones and Park Zones and their included TAs using a set observation route which will be held constant for each park throughout the observational sequences. With 8 target areas per park and 70 total observation periods per park, there will be a total of 560 target area observations made per park and 1,680 total target area observations in the study.

5.2.3 Observations

Observations were conducted in the park and playground environments of Coffee Park, Caruth Park, and Curtis Park in the City of University Park (UP), Texas during the months of February through May of 2015. The observations were done in each park at each time period with the observation day and rotation order being selected randomly. When inclement weather or the significant threat of inclement weather was encountered, the full observation day was rescheduled to the same day of the following week.

Observation Schedule

Observations were done in 2 three week series of observations following the change to daylight savings time on March 8 (Begin CDT) as shown in the Observation Calendar, Figure 5.10. In each series, one observation day was chosen for each of the seven days of the week, selected randomly from the three-week timespan. The first series was conducted in late March and early April, the second series in late April and early May, as shown on the calendar in gray.

Observations were not made during days of inclement weather in either series. Replacement observations for weather or unforeseen conflicts were done on the same day of the week following the canceled randomly scheduled observation day.

Observation Days

TOD-C	Trial Observation Day-Completed
ICC	Intraclass Correlation-Second Observer
RSOD-C	Randomly Chosen Scheduled Observation Day-Completed
RSOD-R	Randomly Chosen Scheduled Observation Day-Rained Out
ROD-C	Rescheduled Observation Day-Completed

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
Week 1	Feb. 15	16	17	18	19 **TOD-C**	20	21	Trial Observations
Week 2	22	23	24	25	26	27	28	
Week 3	**March 1**	2	3	4	5	6	7	
Week 4 UP Spring Break	8 Begin CDT	9	10	11	12	13	14	
Week 5 TAMU Spring Break	15	16	17	18	19	20	21	Observation
Week 6	22 Conflict	23 Conflict	24 Conflict	25	26	**ICC &** 27 **RSOD-C**	28	Week 1
Week 7	29	30	31 **RSOD-C**	**April 1**	2 **RSOD-C**	3	4 **RSOD-C**	ICC 1st Obs. 1 observation
Week 8	5 Holiday	6	7	8 **RSOD-C**	9	10	11	Each Day (7) Picked Randomly
Week 9	12 **RSOD-C**	13 RSOD-R	14	15	16	17	18	From 3 Days
Week 10	19	20 **ROD-C**	21	22	23	24	25	
Week 11	26 **RSOD-C**	27	28 RSOD-R	29	30	**May 1** **RSOD-C**	2	Observation Week 2
Week 12	3	4	5 **ROD-C**	6	7	8	9 **RSOD-C**	1 observation Each Day (7)
Week 13	10	11 **RSOD-C**	12	13 RSOD-R	14 **RSOD-C**	15	16	Picked Randomly From 3 Days
Week 14	17	18	19	20 **ROD-C**	21	22	23	
Week 15	24	25 Mem. Day	26	27	28	UP Last 29 Day School	30	

Figure 5.10: Observation Calendar

The 14 finished randomly chosen observation days are shown on the calendar as indicated in the key. The first observation day on February 19th is the day of the trial observations and data is not included in the analysis. The observation day on March 27th includes a second observer recording the same data for Intraclass Correlation (ICC) statistics. It is shown as "ICC" and is the first day of recorded research observations. There were three days that were scheduled and rained out, April 13 and 28 and May 13 which are shown by "RSOD-R". Their re-scheduled days with completed observations are on April 20 and May 5 and 20 are shown as "ROD-C".

Observation period timing is at 7:30 am, 9:30 am, 12:30 pm, 3:30 pm, and 6:30 pm, using the same times as validated by SOPARC with the addition of an observation at 9:30 am to capture morning playground use. The close proximity of the parks to each other will allow observations to be done at each park during each observation period. Observers move sequentially from one park to another, counting users in each park. Among the three parks, park observation order was chosen randomly for each of the 70 observation periods over the observation days. Randomly chosen park observation order is shown by day and time period in Table 5.5.

Table 5.5: Random Observation Order by Observation Day and Time

	Date	Day	Period 1 7:30am*	Period 2 9:30am*	Period 3 12:30pm*	Period 4 3:30pm*	Period 5 6:30pm*
Week 1	3/27	Friday	3-2-1	3-2-1	3-1-2	2-1-3	2-3-1
	3/31	Tuesday	3-1-2	1-3-2	2-1-3	2-3-1	1-2-3
	4/02	Thursday	2-1-3	1-3-2	3-2-1	3-2-1	2-3-1
	4/04	Saturday	1-3-2	3-2-1	2-1-3	2-1-3	3-1-2
	4/08	Wednesday	2-3-1	3-1-2	1-3-2	2-3-1	3-2-1
	4/12	Sunday	2-1-3	2-1-3	3-1-2	3-2-1	3-1-2
	4/20	Monday	3-2-1	1-3-2	1-2-3	2-3-1	3-1-2
Week 2	4/26	Sunday	2-1-3	2-1-3	1-3-2	2-1-3	1-3-2
	5/01	Friday	1-2-3	1-2-3	3-1-2	1-2-3	3-1-2
	5/05	Tuesday	2-3-1	3-2-1	1-3-2	1-3-2	1-2-3
	5/09	Saturday	3-1-2	1-3-2	3-1-2	1-3-2	1-2-3
	5/11	Monday	3-1-2	1-2-3	3-1-2	1-3-2	3-2-1
	5/14	Thursday	3-1-2	3-1-2	3-2-1	2-3-1	1-3-2
	5/20	Wednesday	3-1-2	2-1-3	1-3-2	2-3-1	3-1-2

*1=Coffee Park, 2=Caruth Park, 3=Curtis Park

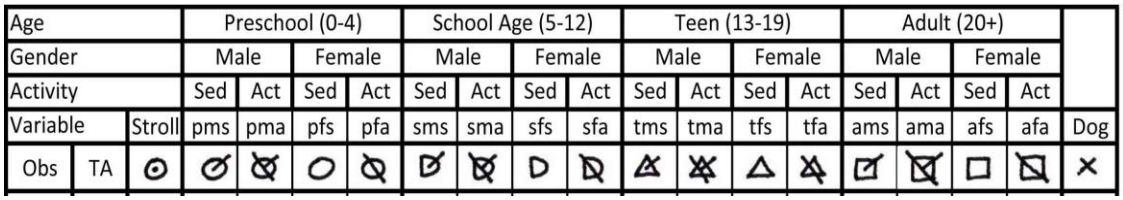
Variables and Recording

The SOPARC protocols define users with four variables, gender, age, race, and physical activity level. Age is defined in four levels as child, teen, adult, and senior. Physical activity level is divided into three levels, sedentary, walking, and vigorous (McKenzie, et al., 2006). Data from both the original pilot study and the trials indicate that high numbers of users will be observed especially in the playground environments. The SOPARC validation study indicates a need for high-reliability scores in observations of 10 or fewer participants and that lower scores are acceptable for observations having 11 or more participants (McKenzie, et al., 2006).

Pilot study data shows combined playground participants of as many as 70 individuals are possible in a given observation (Hurst & Lee, 2014). In response to the potential for high numbers of users in an observation and difficulties found in the trial observations, the physical activity categories from SOPARC are consolidated to improve reliability. They will be

combined into two levels, the first one being Sedentary including sitting and standing, with the second level being Active combining walking, running, and climbing into one level. Age data will be collected on four levels, preschool child, school age child, teen, and adult. For the purposes of analysis, age categories will be combined forming two levels. Preschool and school age are combined to form Child and teen and adult are combined to form NonChild.

Recording was done using a traditional paper format that will combine a map or plan of the park divided into each of the observation areas with a summary form. The summary form is patterned from SOPARC observation categories (McKenzie, et al., 2006) using symbols original to this research. The form represents the combined 16 levels of the variables that each observed individual could possibly take on. In addition, children in strollers will be recorded, dogs seen on site will be recorded and people using mobility assistive devices will be recorded for each of the 16 categories by filling in the symbol if the observed participant is using a mobility device. The symbols are shown in Figure 5.11, the full form is shown in APPENDIX ONE.



Activity Key: Child in Stroller (Stroll), Lying, Sitting or Standing (Sed), Walking or Running (Act)

Figure 5.11: Observation Symbols

Observations were made by a single observer throughout the research who recorded the presence of the subject on a set of site plans for each park. For each park, an overall plan of the park was used to record the mediator variable of Park Use in the park environment or Park Zones and a larger scale plan of the playground was used to record the dependent variable of

Playground Use in the playground environment or Playground Zones. The plans show park and playground features, accommodations, affordances, target areas, and observation paths for observational consistency as directed by SOPARC (McKenzie, et al., 2006). Participant locations within the park and playground environments were graphically recorded with the symbols reflecting the subject's age, gender, and physical activity level. The park and playground site plans are shown in APPENDIX ONE.

5.2.4 Inter-rater Reliability: ICC

During the first day of the research observations, on March 27th, 2015, a second observer was used along with the primary observer to conduct Intraclass Correlation (ICC) reliability data. Public parks and especially playgrounds have highly dynamic user environments where both adults and children engaged in active forms of physical activity are often in different locations only moments apart. To ensure consistency in the subjects recorded, the two observers walked the same route together in the parks but made data recordings separately and independently.

The one-way random effects model was used to evaluate the correlation between the 2 observers. On the day of evaluation, observations were made at three parks, during 5 time periods, with 2 rotations per time period resulting in 30 separate observations for each observer. Users were recorded in 8 separate target areas during each observation resulting in a total of 240 targets as described for use in ICC statistics (Stata.com, 2015). Results of the Stata ICC analysis are shown in the following Table 5.6.

Table 5.6: Intraclass Correlation Agreement

Number of targets = 240, Number of raters = 2

Rating	ICC	(95% Confidence Interval)	
INDIVIDUAL	0.999	0.998	0.999
AVERAGE	0.999	0.999	0.999

F test that ICC=0.00: f(239.0, 239.0) = 1761.42 Prob > F = 0.00

The ICC analysis shows a high level of agreement with all levels being over 0.99. The F statistic reports F (239, 239) = 1761.42, $p<0.001$. These statistics give support to the strong inter-rater reliability of the observations accurately reporting conditions throughout the research data gathering.

5.2.5 Quality Check

The original field data was recorded by using graphic symbols, generally one for each participant. In certain cases of high user numbers, one symbol is used for groups of persons with similar attributes in a small area along with a number representing the numbers of users the symbol represents. This was mostly done in active sports areas of the park. Data was first transcribed from the graphic map to a tally sheet for entry into the Excel spreadsheet at a later time. Data was then entered by the researcher into the spreadsheet in a raw format matching that of the tally sheet. Data entry was done as the research was ongoing during March, April, and May of 2015.

Following data entry, a day was randomly selected finding an error rate of under 2%. While this error rate is less than the normally accepted 5% considered for statistical significance, it was thought to be excessive. As a result, the data from each day's observations was checked

and corrected in May and June of 2015, entry by entry for all observations. There was a total of 305 errors found out of 12,465 entries for an overall error rate of 2.45% before correction.

In December 2015, during analysis, the data was re-entered by affordance in the Park Zone and the Playground Zone rather than by Target Area as was done in the original data entry. As a part of the re-entry process, the new entries were correlated with the original ones to verify agreement. When disagreement was detected, the original data was consulted and the discrepancy was resolved. During that process, there were 42 additional errors found out of 12,496 entries for an overall error rate of 0.336%. These errors were corrected in both the original set of variables by Target Area and in the new variables by Affordance.

5.3 Data Analysis

Data entry and descriptive statistics were done using Microsoft Excel version 13.0, and Stata version 14.0 was used for advanced statistics including ANOVA and Regression analysis. The unit of analysis for this research is at the observation level (n=210) (Colabianchi, et al., 2011), although in its foundation, the construct of the hypothesis is at the park level unit of analysis (n=3).

5.3.1 Primary Aim

Analysis was done on the target areas combined to make up the Park and Playground Zones using a combination of descriptive statistics, ANOVA, and regression. Descriptive statistics are used to establish the basic relationships of park use and playground use between the Case and Comparison parks. Mean use levels across the parks and in the Park Zones and the Playground Zones are given a preliminary analysis of the basic use relationships relative to the hypothesis. Standard deviations are compared with the variance to check for overdispersion and

histograms are used to evaluate distribution patterns. Beyond the basic statistical relationships in the different Zones, use levels across weekends and weekdays, and the five observation time periods are analyzed. Lastly, user characteristic data of age and physical activity are analyzed for relationships of demographics and types of use.

Hypothesis

Descriptive statistics are followed by ANOVA to check the significance levels of the relationships analyzed descriptively. Differences in the mean use between parks and play areas are assessed by doing comparative ANOVA runs and checking for support of the hypothesis under a variety of conditions. Comparative conditions include weekend/weekday use, use in the 5 time periods, use under different cloud cover conditions, and use under different classes of temperature conditions.

Multivariate analysis is used to account for effects potential confounding variables have on the dependent variable in the playground zones between the Case and Comparison parks. The observation data gathering was done by counting and recording individuals using the playground. As such, count models such as Poisson Regression would appear appropriate. Poisson and Negative Binomial Regression, and their zero-inflated variants are analyzed in the following Results section to identify the most appropriate model driven by the distribution curve and a number of zeros in the data.

5.3.2 Secondary Aims

Following multivariate analysis of the observations divided into Park and Playground Zones, the observation data is re-categorized by affordance centered behavior settings looking at users observed in areas having ten separate categories of affordance. This exploratory analysis is

primarily descriptive and qualitative and is anticipated to yield general information on the relationships different affordances have with respect to their contribution to use. The final analysis is done from the perspective of physical activity in an effort to identify where park users are most active. This analysis is anticipated to further the understanding of how people interact with park elements as evidenced by their behaviors from a qualitative perspective.

Use of Affordances

The exploratory analysis is begun by shifting the data from being based on Target Areas as was originally conceived in response to following the SOPARC protocols to an Affordance Based Behavior Setting classification focusing on park and playground features more similar to behavior mapping work (Moore & Cosco, 2007). These behavior setting classifications are shown in Table 5.7. The primary divisions by Park Zones and Playground Zones will remain the same for consistency. Adding to the primary aim of the research being in the play environments, the inclusion of the associated park data lends itself to greater richness by complimenting the exploratory use analysis of the Playground Zones with analysis of the Park Zones as well.

Table 5.7: Affordance Based Behavior Settings in the Park and Playground Zones

Park Zones (TA 1-4)	Playground Zones (TA 5-8)
Gathering Areas	Gathering Areas
Site Furnishings	Site Furnishings
Active Sports Areas	Shelter
Trails	Play Structure
	Swings
	Play Surfacing

There are four different affordance settings within the Park Zones. They are active sports areas, trails, gathering areas, and site furnishings such as picnic tables and park benches. These Affordance Based Behavior Settings are shown for each of the three parks in Figure 5.12.

In the Playground Zones, there are the similar gathering areas and site furnishings areas as in the Park Zones. Additionally, there are shelter areas, the play structure, swingsets, and playground surfacing areas around the equipment. The shelter area is unique to Coffee Park and is included to check its possible confounding effect. These Affordance Based Behavior Settings are shown in Figure 5.13.

The original observation data is re-organized for this analysis and divided by the Affordance classes. Descriptive statistics are tabulated and charted to evaluate use patterns by age, gender, and physical activity. Development of GIS-based data analysis of the data is beyond the scope of this research although use on a representative sample day will be graphically presented for each park and playground zone for pattern analysis.

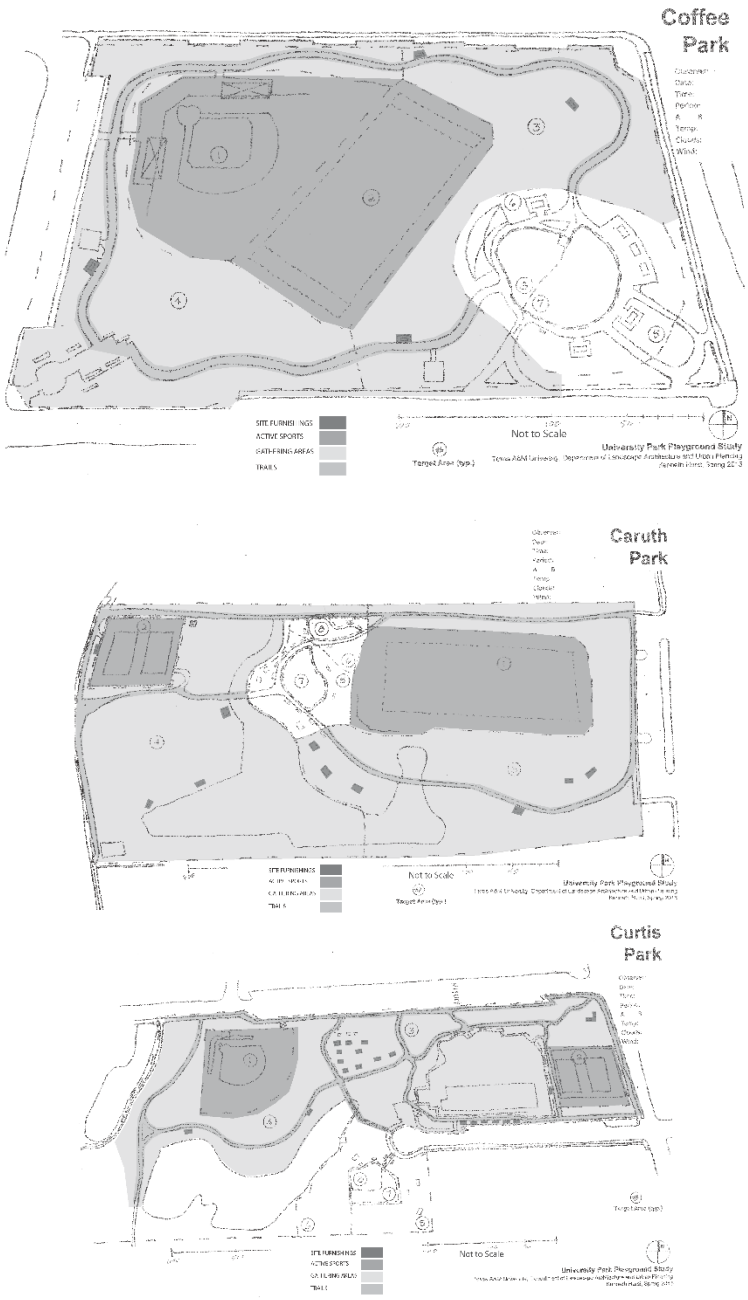


Figure 5.12: Affordance Based Behavior Settings, Park Zones

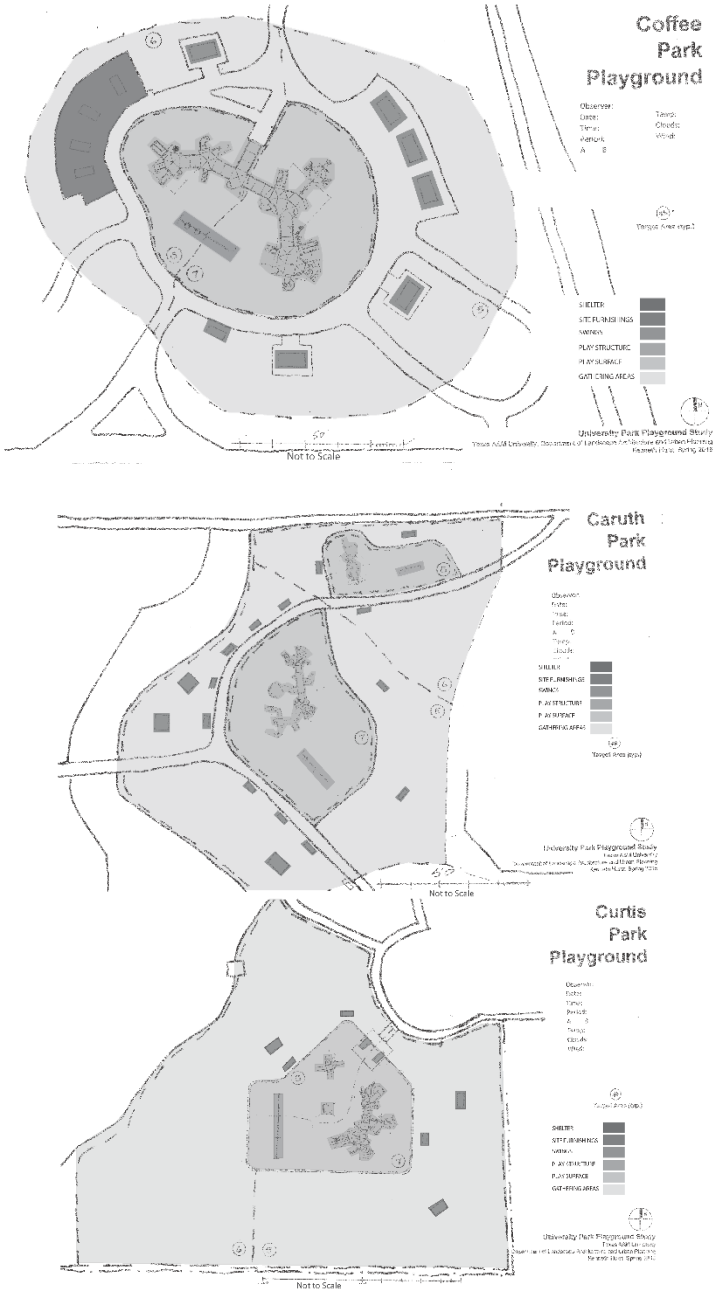


Figure 5.13: Affordance Based Behavior Settings, Playground Zones

Physical Activity

The final aim is to evaluate physical activity in terms of metabolic equivalents (METs) that have been an established methodology in the analysis of physical activity in a variety of research settings (Cosco, et al., 2010; Van Dyck, et al, 2013). MET units are a scale that can represent energy expended by park users and provide a basis for comparing physical activity across different parks and settings (Ainsworth, et al., 2011). The use of METs as a measure of energy expended in physical activity is applied to the different settings in each park and a comparison will be made between settings and between parks.

6. RESULTS

The focus of this research is found in the primary aim and hypothesis, addressing the specific application of universal design applied to playgrounds in public parks. For the purpose of evaluating any potential confounding effects of park activity, data was collected beyond just the playgrounds to include the entire park. Exploratory evaluation of this data is done in the secondary aims to look for relationships that are outside of the hypothesis but may have merit in supporting future research and design decisions.

6.1 Primary Aim

Compare the association between the applications of Universal Design (UD) principles in playground design with levels of use in comparative playground environments applying UD in comparison with those using Accessible Design (AD) standards. Descriptive statistics were run on the basic relationships found between use in the Park Zones (TA 1-4) and Playground Zones (TA 5-8), and in the proportions of age groups, gender, and physical activity levels. The numbers of users in the Park Zones and the Playground Zones are compared as a percent of total park use in each of the parks. In all of the rotations of observations, there was a total of 12,520 individuals recorded in the course of the field work. When the two observation rotations per observation period are averaged in accordance with the SOPARC protocols, the resulting total users is a mean of 6,260 users (McKenzie & Cohen, 2006b). This averaging has the possibility of returning either a whole number or a decimal number of one-half of a user when reported in different categories at the observation level.

Hypothesis: Playgrounds designed to the higher standard of UD, will be used more by people of all abilities versus playgrounds designed using AD standards. The first level of

hypothesis testing will be conducted using One-Way Analysis of Variance (ANOVA) evaluating the mean observations of the Playground Zones (TA 5-8) to estimate the significance of differences in use levels between UD in Coffee Park (Case) and AD in Caruth Park and Curtis Park (Comparisons). Evaluations will also be done on the Total Users (TA 1-8) and Park Zones (TA 1-4) using ANOVA to see if there may be a significant influence on use from the overall park activities. Further analysis will be done in the playground TAs by breaking out use in weekend days versus weekdays, in the five observation time periods, and under different weather conditions for analysis to check for consistency with the original playground area use analysis. Regression analysis will then be done on UD and these variables, then on ten physical park feature variables to evaluate for influence and significance.

6.1.1 Descriptive Analysis

In accordance with the SOPARC protocols, two rotations were done in an observation period and then averaged leading to a mean number of observed users per observation period for each park. There is a combined total of 6,260 mean users which are then broken down into users in each park and then divided into Park Zones (TA 1-4) and Playground Zones (TA 5-8). In the entire park area, the split between use in the Park and Playground Zones is slightly in favor of the Park Zones with 54% of use. By park, Caruth and Curtis parks have over 60% of their use in the Park Zones while Coffee has only 34%. The inverse is seen in the Playground Zones where Coffee sees 66% of use and Caruth and Curtis see 38% and 33% respectively. Qualitatively, this would suggest that the lower level of park activity at Coffee Park, does not pose a confounding effect on playground use.

The unit of analysis is then transformed to the observation level by converting total users to mean users per observation. Histograms are shown in Figure 6.1, graphing the observations in the Playground Zones of each park illustrating a distribution that does not follow a normal bell curve pattern. The histograms also show significant outliers giving further indication of a nonparametric condition. Along with evidence of a nonparametric curve, many observations have a zero value. Four of the six Zone area breakouts show a minimum range of zero with the lower end of the range being 2 or less in all of the cases including the total.

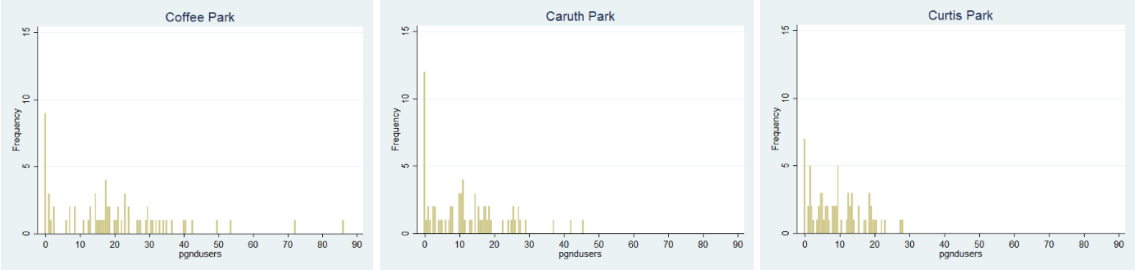


Figure 6.1: Mean Users/Observation in the Playground Zones by Park

In the Entire Park setting, all of the observations recorded some use, although when divided by Zones, there was a total of 32 observations having zero users observed, the majority of which were in the Playground Zones with 28 observations recording zero users. In the Playground Zones, all parks have a minimum observation level of zero with over 10% of the observations recording zero users in each of the playgrounds. All of the playground zero user observations were made during the first observation time at Dawn (7:30 am) with only one exception. The exception was where one zero observation was made in the Caruth Park playground during the last observation time Evening (6:30 pm). These zero observations

contribute to support of the data being nonparametric and will be given further consideration in the multivariate analysis.

Mean numbers of users observed per observation period are shown in Table 6.1 along with the percent use each period represents for the day categorized by Park Zones (TA 1-4) and Playground Zones (TA 5-8). Within the data, there is a broad range reported between the minimums and maximums in most of the items. Patterns readily visible through the descriptive statistics reveal light use across all of the areas in the first observation period across all the parks.

Distribution is somewhat different between the Park Zones and Playground Zones with the Park Zones seeing generally greater use in the two later time periods while the Playground Zones experience their greatest use during the three mid-day periods. During the Dawn time, Curtis Park shows high use in the Park Zones as a result of neighborhood children and parents walking through the park on their way to school. All of the Park Zones exhibit their highest use in the evening period while the Playground Zones show a reduction of use in the evening periods. Of the three parks, Curtis Park shows the highest use levels of the Park Zones in the two later time periods and Coffee Park shows the highest use in the Playground Zones across the three mid-day time periods.

Table 6.1: Observed Users by Zone per Park

	COMBINED TOTAL (n=210)			COFFEE (Case) (n=70)			CARUTH (Comparison) (n=70)			CURTIS (Comparison) (n=70)		
	Users(SD)	%	R	Users(SD)	%	R	Users(SD)	%	R	Users(SD)	%	R
ENTIRE PARK (TA 1-8)												
Total Users	6,260.0	100[1]		2,089.5	33.3[1]		2,209.0	35.3[1]		1,961.5	31.3[1]	
Mean Users/Obs.	29.8(24.6)		1-99	29.9(24.7)		1-98	31.6(26.0)		2-99	28.0(23.3)		2-98
PARK ZONES (TA 1-4)												
Total Users	3,384.5	54[1]		718.0	34[1]		1,359.5	62[1]		1,307.0	67[1]	
Mean Users/Obs	16.1(18.4)		0-91	10.3(15.2)		0-63	19.4(18.8)		2-76	18.7(19.9)		1-91
T1 - (7:30 am)	5.0(5.1)	6.2[3]	1-25	1.3(0.55)	2.4[3]	1-3	4.6(2.4)	4.8[3]	2-9	9.1(6.5)	9.7[3]	1-25
T2 - (9:30 am)	9.7(14.2)	12.0[3]	0-73	3.9(4.4)	7.7[3]	0-14	18.7(21.8)	19.2[3]	4-73	6.4(3.5)	6.9[3]	1-15
T3 - (12:30 pm)	11.5(15.7)	14.2[3]	0-73	4.4(9.2)	8.6[3]	0-35	20.6(21.0)	21.3[3]	4-73	9.3(10.2)	10.0[3]	2-42
T4 - (3:30 pm)	24.1(15.9)	29.9[3]	1-68	19.0(17.3)	37.0[3]	1-48	24.6(12.5)	25.4[3]	6-44	28.6(17.2)	30.6[3]	7-68
T5 - (6:30 pm)	30.4(23.23)	37.7[3]	2-91	22.7(20.1)	44.2[3]	2-63	28.5(20.8)	29.3[3]	7-76	40.0(26.4)	42.8[3]	11-91
Weekday	15.2(18.3)		0-91	9.0(15.3)		0-63	16.6(15.4)		2-76	20.1(22.0)		1-91
Weekend	18.4(18.7)		1-73	13.4(14.6)		1-48	26.5(24.3)		2-73	15.2(13.1)		1-50
Obs w/Zero Users	4	1.9[4]		4	5.7[4]		0	0[4]		0	0[4]	
PLAYGROUND ZONES (TA 5-8)												
Total Users	2,875.5	46[1]		1,371.5	66[1]		849.5	38[1]		654.5	33[1]	
Mean Users/Obs	13.7(12.8)		0-86	19.6(16.6)		0-86	12.1(10.7)		0-46	9.4(7.3)		0-28
T1 - (7:30 am)	0.5(0.8)	0.8[3]	0-3	0.5(0.8)	0.5[3]	0-3	0.3(0.7)	0.5[3]	0-3	0.8(0.9)	1.8[3]	0-3
T2 - (9:30 am)	14.6(13.7)	21.4[3]	1-86	22.8(19.9)	23.3[3]	3-86	13.5(6.4)	22.2[3]	4-28	7.6(5.2)	16.2[3]	1-21
T3 - (12:30 pm)	17.8(13.6)	25.9[3]	3-72	26.8(16.4)	27.4[3]	7-72	16.6(11.6)	27.4[3]	3-42	9.8(4.4)	20.9[3]	5-19
T4 - (3:30 pm)	23.4(11.4)	34.2[3]	2-54	30.6(12.7)	31.2[3]	6-54	21.2(11.2)	35.0[3]	2-46	18.4(6.0)	39.4[3]	6-28
T5 - (6:30 pm)	12.2(6.5)	17.8[3]	0-30	17.3(6.1)	17.6[3]	9-30	9.0(4.9)	14.9[3]	0-17	10.1(5.2)	21.7[3]	2-19
Weekday	12.8(11.7)		0-72	18.6(15.3)		0-72	10.7(9.1)		0-37	9.1(6.7)		0-23
Weekend	15.9(15.2)		0-86	22.0(19.6)		0-86	15.8(13.3)		0-46	9.9(8.7)		0-28
Obs w/Zero Users	28	13.3[4]		9	12.8[4]		12	17.1[4]		7	10.0[4]	

R - Range

[1] Percent of observed use Entire Study
[2] Percent of Entire Park (TA 1-8) use
[3] Percent of observed use per Zone (TA 1-4 or TA 5-8)
[4] Percent of observations (n=210 or n=70)

Weekday versus weekend day use has been tabulated for the Park Zones (TA 1-4) and the Playground Zones (TA 5-8) to look for differences between weekday and weekend use patterns in each of the three parks. In the Park Zones, weekend use is higher in the Combined condition and in both Coffee and Caruth Parks. Curtis Park shows higher weekday use in the Park Zones, possibly as a result of being across the street from University Park Elementary School. That pattern does not repeat in the Playground Zones of Curtis Park, where the Playground Zones of all of the parks and the Combined condition exhibit higher weekend use. With the exception of the Park Zones in Curtis Park, there was generally higher weekend use found across the parks.

Use by Age Group

Ages of the users were tabulated by Child versus Non-Child to look for patterns of age group makeup across the parks and target areas. In the Park Zones, children generally represent nearly 40% of the users with the Case, Coffee Park showing approximately 7-10 percentage points more children in the Park Zones than the comparisons or the combined mean. Percentages of child users are approximately one-third higher in the Playground Zones than in the Park Zones and are also higher in Coffee Park, but by a lower margin. As expected, there is a higher percentage of children found in the Playground Zones than in the Park Zones. Percentages are shown in Table 6.2, the complete tables with the means are shown in APPENDIX TWO Table 6.2.1a, Table 6.2.2a, and Table 6.2.3a.

Table 6.2: Percent of Users by Age Group, Gender, and Physical Activity per Park

	COMBINED (n=210)	COFFEE (Case) (n=70)	CARUTH (Comparison) (n=70)	CURTIS (Comparison) (n=70)
ENTIRE PARK (TA 1-8)				
Percent Child	46.7%	54.2%	44.2%	41.5%
PARK ZONES (TA 1-4)				
Percent Child	38.0%	45.1%	37.3%	34.9%
Child Percent Active	79.7%	79.1%	77.5%	82.5%
Percent Male	68.0%	87.2%	58.1%	65.3%
Male Percent Active	81.7%	82.4%	76.7%	85.9%
Female Percent Active	75.5%	57.6%	78.5%	76.1%
Non-Child Percent Active	53.8%	40.7%	59.3%	54.5%
Percent Male	51.0%	52.0%	50.4%	51.0%
Male Percent Active	56.4%	49.5%	58.6%	57.4%
Female Percent Active	51.2%	31.1%	60.0%	51.4%
PLAYGROUND ZONES (TA 5-8)				
Percent Child	56.9%	58.9%	55.4%	54.8%
Child Percent Active	79.7%	81.6%	78.7%	76.6%
Percent Male	50.1%	53.3%	47.3%	46.5%
Male Percent Active	88.3%	89.1%	87.4%	87.4%
Female Percent Active	71.0%	73.1%	70.9%	67.2%
Non-Child Percent Active	49.5%	49.6%	50.1%	48.5%
Percent Male	24.7%	24.5%	24.5%	25.3%
Male Percent Active	53.8%	53.8%	51.1%	57.0%
Female Percent Active	48.1%	48.3%	49.9%	45.6%

User participation of active versus sedentary behavior is summarized for the Combined Total and for each park broken down by Park Zones (TA 1-4) and Playground Zones (TA 5-8) and by age grouping of Child and Non-Child. Active behavior is defined as either walking or running which includes climbing, sliding, and swinging when the user is not being pushed. Across the parks and target areas, there is a similar pattern of approximately 80% of the children having been observed in active behavior. Non-children were approximately 50% active with a higher activity rate shown in the Park TAs of Caruth and Curtis Parks.

In the Playground Zones, the gender split among children is essentially equal, and physical activity levels are similarly high for both boys and girls with boys being slightly more

active in the upper 80th percentile active and girls being in the lower 70th percentile active. There is a low percentage of Non-Child males in all of the playground environments having only 25% in each instance making females 75% of nonchildren. Of those, females are only slightly less active with just over half of the males being active and just under half of the females being active.

The Park Zones show a somewhat different distribution in children, where more than half are male at over 60%. Physical activity levels among boys and girls are more even overall and similar to that in the playground areas with just over 80% active among boys and an overall average of over 75% active for girls. The gender split for non-children is nearly even with both male and female overall active physical activity behaviors being just over 50%.

Summary

There were 420 total observations done, 2 in each observation period, then averaged as directed in the SOPARC protocols (McKenzie, et al., 2006). Of those observations, 3 were influenced by events outside of the normal operations. In Coffee Park, there was one weekday noontime observation (3/31) where two buses from Dallas County Schools were present bringing an unusually high number of children resulting in an average of 72 for that period. There was also a weekend birthday party during the morning observations at Coffee Park (5/9) that added to high weekend use and resulted in an average of 86 users for that time period. In Caruth Park, there was an Easter egg hunt (4/4) in the Park Zone adjoining the playground which increased the Playground Zone users to 45 for that time period. These special events represent some of the highest of the outliers. Rather than taking them out as outliers, the events could be considered to be in support of the hypothesis by demonstrating the Case playground provides a more attractive destination for these activities.

These descriptive statistics show substantially more playground users in the Case versus the Comparisons and an inverse relationship of substantially more park users in the Comparisons than in the Case. The Comparisons having more use in the Park Zones, would give support to the increased use in the playground of Coffee Park being driven by the playground itself rather than as a result of activities that are going on in the park as a whole.

6.1.2 Bivariate Analysis

When there are three or more groups and the research question involves evaluating the differences between groups it is often appropriate to use a one-way analysis of variance (ANOVA) to see if there is a significant difference in the outcome or the dependent variable. Using ANOVA, the researcher can compare mean scores between groups returning significance levels as a type of a two-sample t-test. Assumptions for ANOVA are:

- Random sampling
- Similar numbers of observations in each group
- Normal distribution of the outcome variable
- Equal variance among the groups

The observations were sampled using a systematic random sampling of the observation days and also a systematic random sampling of the observation order within the given observation times in accordance with the first assumption. Observation numbers were identical between groups (n=70) which satisfy the second assumption and reduces the importance of the last assumption of equal variances. Normal distribution is critical with small samples and less so with larger samples. A mean of 6,260 observed individuals and 210 observations would places this dataset above a small sampling but less than a large sampling (Acock, 2012).

In the three parks as a whole, the mean users in all of the target areas as Entire Park (TA 1-8) are found in the ANOVA analysis to be very similar as shown in Table 6.3. Mean numbers of users per observation at Coffee Park, the Case, is in the middle of the range of the Comparisons being lower than Caruth and higher than Curtis for the entire park area including all eight target areas (TA 1-8). The MS between groups is lower than that within groups indicating a relationship between the means and the F values, Bartlett's, and Krusgall-Wallis show very high p values failing to reject the null hypothesis that there is a similarity in the means.

Mean user levels in the Playground Zones (TA 5-8) show Coffee Park, the Case, having higher use than in the Comparisons, Caruth, and Curtis. The Mean Sum of Squares (MS) is large between groups and small within groups which are expected in support of the differences between the mean user per observation values in the playground areas between parks but similarities within the playground areas of each park. The F test statistic is computed by dividing the between groups MS by the within groups MS ($F=1963.3/147.2 =13.34$). The F test returns with a statistically significant result $F(2, 207) = 13.34$, $p<0.001$ (Acock, 2012) giving support to the means being significantly unequal between the Case and the Comparisons.

Use in the Park Zones (TA 1-4) shows Caruth Park and Curtis Park to have the highest mean users per observation, nearly double that of Coffee Park. The MS is also larger between groups than within groups indicating a difference between the means of park use. The F test is also significant showing the means to be unequal but in contrast to the Playground Zones, it is the Comparisons having the higher means than the Case.

Table 6.3: ANOVA Users/Observation by Entire Park (TA 1-8), Park (TA 1-4), and Playground (TA 5-8) Users

			Entire Park (TA 1-8)	Park (TA 1-4)	Playground (TA 5-8)
	Frequency	n=	70	70	70
Mean	Coffee Park		29.85	10.26	19.59
	Caruth Park		31.56	19.42	12.14
	Curtis Park		28.02	18.67	9.35
ANOVA	MS Between groups		218.9	1812.4	1963.3
	MS Within groups		609.3	325.9	147.2
		F (2 d.f.)	0.36	5.56	13.34
		p<	0.70	0.004	0.001
Comp*	Coffee-Caruth	p<	0.92	0.012	0.002
	Coffee-Curtis	p<	0.91	0.024	0.001
	Caruth-Curtis	p<	0.70	0.970	0.399
Kruskall-Wallis	Coffee	Rank Sum	7338	4962	9050
	Caruth	Rank Sum	7660	8804	6953
	Curtis	Rank Sum	7158	8390	6153
		Chi2 (2 d.f.)	0.50	34.40	17.32
		p<	0.78	0.001	0.001
	Bartlett's:	Chi2 (2 d.f.)	0.81	5.28	45.10
		p<	0.67	0.071	0.001

*Scheffe Multiple-Comparison Adjustment

With the significance of the ANOVA assumptions having support, multiple comparison tests are run to further cross-evaluate the differences of the means. Three multiple comparison tests are available in Stata, Bonferroni, Scheffe, and Sidak. Each was run with similar results. In the interest of reporting efficiency, the results of the least affirmative, Scheffe, is reported from the Stata output in these analyses. In the case of the Entire Park, the mean users in the three parks do not show a significant difference in their means, while in the Park Zones and Playground Zones individually, a significant difference between the means of the Case and the Comparisons are reported. There is not a significant difference between the means between the Comparisons in either of the Park or Playground Zones.

The Bartlett's test of variance evaluates the ANOVA assumption that variances across groups are the same. In this case, the results of Bartlett's test rejects ($p<0.01$) that the variances are the same between groups within the Park and Playground Zones but does not reject ($p<0.70$) that the variances are the same in the combined areas (TA 1-8). The Bartlett's test of variance is sensitive to non-normal (nonparametric) distributions which are the condition of this data confirmed by the histograms which showed a high number of zeros and outliers without having a normal bell curve. The assumption of equal variance is thought to be less important in practice when the number of cases is similar, where this dataset has equal numbers of cases (Acock, 2012).

Application of the Kruskal-Wallis equality of rank test contributes in the nonparametric environment offering an alternative when some of the ANOVA assumptions are not met, particularly in the case of the non-normal distribution and equal variance assumptions as is the case with this data. The data from the groups are given ranks rather than the reported means. The test uses chi-squared with ties to return a report of significance levels where high significance indicates support for a difference between the means. Output from Stata shows the null hypothesis can be rejected ($p<0.001$) in both the Park and the Playground Zones but not in the Entire Park ($p<0.80$) and gives support to a significant similarity between the means of the three parks on the basis of the Entire Park areas, and a significant difference between the means of the observed users in the Playground Zones of the parks.

Weekend versus Weekday Use

The mean user counts in weekdays versus weekends in the Playground Zones (TA 5-8) were presented earlier as descriptive statistics. Higher use levels on weekends has been previously established. Table 6.4 presents the ANOVA evaluation of the differences in the

means of the Playground Zones (TA 5-8) to test the hypothesis for differences in support during weekday and weekend days. Of the 70 total observations (n=70) done per park on 14 days, 50 observations were done (n=50) on 10 weekdays, and 20 were done (n=20) on 4 weekend days. This division of the observations creates a statistical challenge where it is often considered in practice that 30 observations (n=30) are the optimal minimum number of observations for statistical significance. The 20 weekend observations are considerably fewer than this optimal minimum.

Table 6.4: ANOVA Playground (TA 5-8) Users/Observation by Weekday and Weekend

			Weekday	Weekend
	Frequency	n=	50	20
Mean	Coffee Park		18.63	22.00
	Caruth Park		10.67	15.80
	Curtis Park		9.12	9.93
ANOVA	MS Between groups		1301.7	729.2
	MS Within groups		121.2	212.5
		F (2 d.f.)	10.74	3.43
		p<	0.001	0.039
Comp*	Coffee-Caruth	p<	0.002	0.411
	Coffee-Curtis	p<	0.001	0.039
	Caruth-Curtis	p<	0.781	0.449
Kruskall-Wallis	Coffee	Rank Sum	4647	741
	Caruth	Rank Sum	3451	612
	Curtis	Rank Sum	3228	477
		Chi2 (2 d.f.)	12.33	5.71
		p<	0.002	0.057
	Bartlett's:	Chi2 (2 d.f.)	33.78	11.70
		p<	0.001	0.003

*Scheffe Multiple-Comparison Adjustment

On weekdays, ANOVA reports the statistical significance of the difference in the means to have strong statistical significance with F test returning a statistically significant result $F(2, 147) = 10.74$, $p<0.001$ giving support to the means being significantly unequal. The Scheffe test shows similar results as shown earlier ($p<0.002$, $p<0.001$). The Kruskall-Wallis one-way analysis of variance that is appropriate for the non-parametric condition of the data is significant for the weekday observations at $p<0.002$.

In the weekend observations, the F test is also statistically significant $F(2, 57) = 3.43$ $p<0.039$. The Scheffe multiple-comparison adjustment reports a statistically insignificant result for the comparison between Coffee and Caruth ($p<0.041$) but a statistically significant result for the comparison between Coffee and Curtis ($p<0.039$). The Kruskall-Wallis one-way analysis of variance is borderline significant at $p<0.057$. Weekend ANOVA results are statistically weaker than the weekday and overall results, possibly influenced by the higher weekend use rates in Coffee and Caruth, but also because having only 4 observation days, the resulting 20 observations (n=20) are lower than would be optimal.

Overall, the weekend and weekday use figures show higher use levels in the playground areas on the weekends. The data shows strong support for the hypothesis during the weekdays and mixed to moderate support for the hypothesis on weekend days. Results of the analysis of weekend and weekday activity would tend to be more in support of the hypothesis than otherwise.

Observation Time Period

Observations were conducted during five discreet time periods on each of the fourteen observation days. Analysis by time period divides the 70 observations (n=70) into five equal groups of 14 observations (n=14) per park in each of the time periods. This division of

observations leaves each of the time periods with just less than half of the 30 observations that would be considered optimal (n=30), yet an examination of the differences is done to evaluate for consistency of support for the hypothesis across the time periods. ANOVA results of observations in the Playground Zones (TA 5-8) are shown in Table 6.5.

Table 6.5: ANOVA Playground (TA 5-8) Users/Observation by Time Period

			Period 1 7:30am	Period 2 9:30am	Period 3 12:30pm	Period 4 3:30pm	Period 5 6:30pm
	Frequency	n=	14	14	14	14	14
Mean	Coffee Park		0.50	22.79	26.82	30.57	17.29
	Caruth Park		0.29	13.50	16.64	21.21	9.04
	Curtis Park		0.82	7.57	9.79	18.43	10.14
ANOVA	MS Between groups		1.02	823.3	1028.6	566.5	280.7
	MS Within groups		0.65	155.0	141.5	108.0	29.4
		F (2 d.f.)	1.58	5.31	7.27	5.25	9.55
		p<	0.22	0.009	0.002	0.010	0.001
Comp*	Coffee-Caruth	p<	0.78	0.16	0.09	0.07	0.001
	Coffee-Curtis	p<	0.58	0.01	0.01	0.01	0.005
	Caruth-Curtis	p<	0.22	0.46	0.32	0.78	0.87
Kruskall-Wallis	Coffee	Rank Sum	296	410	420	406	432
	Caruth	Rank Sum	254	318	289	266	223
	Curtis	Rank Sum	353	176	195	231	249
		Chi2 (2 d.f.)	2.34	13.13	12.07	8.14	12.28
		p<	0.310	0.001	0.002	0.017	0.002
	Bartlett's:	Chi2 (2 d.f.)	0.89	26.90	17.57	6.78	0.62
		p<	0.64	0.001	0.001	0.034	0.733

*Scheffe Multiple-Comparison Adjustment

Of the time periods, Period 1, 7:30 am shows the least use in the Playground Zones (TA 5-8) with a mean of less than one person recorded per observation. There is no recognizable statistical significance in the ANOVA, Multiple-Comparison, or Kruskall-Wallis tests, a likely

result of the low observation numbers, low number of observed subjects, and the relative equality of the means. This early time period was applied from the SOPARC protocols which have a goal of assessing overall park use rather than specifically assessing playground area use. Low levels of both park and playground use would be within expectations for this early time period.

In Periods 2-5, the mean people per observation are all at higher levels with the Case, Coffee Park showing the greatest numbers. The number of mean users per observation grows consistently across the Case and the Comparison parks from Period 2 through Period 4, then drop off at the end of the day in Period 5. All time periods show statistical significance F (2, 39) 5.31, 7.27. 5.25, 9.55; $p<0.009$, $p<0.002$, $p<0.010$, $p<0.001$ respectively. The Scheffe Multiple-Comparison Adjustment shows mixed results across the four later time periods. Kruskall-Wallis non-parametric one-way analysis of variance does show strong significance across the four later time periods.

Analysis by time period reveals some interesting but not surprising patterns of use with numbers peaking after school is out in the late afternoon time period. Statistical significance is not universal across all of the measures but with the low numbers of observations in each of the time periods, statistical weakness could be justified. Overall, the results of the observations would tend to give support to the research hypothesis.

Weather

The observations were done in relatively moderate conditions during late March through May in the Texas spring season. In all cases, temperatures were well above freezing and below 90° Fahrenheit with a mean temperature of just over 72°. Observations on rainy days were re-

scheduled so precipitation was limited to a handful of instances of a light misting rain. Cloud cover ranged from clear to partly cloudy to cloudy.

The mean temperature, standard deviation, and range of the recorded temperatures and the Likert ratings for numbers of observations categorized by temperature range and varying levels of cloud cover are shown in Table 6.6. The temperature range shows relatively mild conditions with a minimum recorded temperature of 47 and a maximum of 88, none were in the range of freezing nor were they excessively hot. The mean of 72.5 is very temperate and falls within the largest number of temperature ratings with 101 observations being in the 70s representing nearly half of the total observations (n=210). Cloud cover ratings were dominated by nearly equal numbers of clear and cloudy conditions with 180 of the 210 observations being either clear or cloudy.

Table 6.6: Summary of Weather Variables

(n=210)	Mean	Std. Dev.	Min	Max
Temperature (°F)	72.5	8.6	47	88
WEATHER RATING:	0	1	2	3
Rated Temperature[1]	16	44	101	49
Rated Cloud Cover[2]	91	27	89	3

[1]0=<60°, 1= 60°s, 2=70°s, 3=>=80°

[2]0=Clear, 1=Partly Cloudy, 2=Cloudy, 3=Mist

The means of the observed users per observation were higher at Coffee Park than at the comparisons across the Clear, Partly Cloudy, and Cloudy conditions. With the exception of the third category, Misting Rain which had only 3 observations, the cloud cover categories returned statistics with significance levels consistent with the previous ANOVA analysis. Within groups,

Mean Sum of Squares (MS) was lower than the between groups as expected and the F Tests were all well within the range of statistical significance as shown in Table 6.7. The multi-comparison adjustment did not show significant levels of difference between Coffee Park and Caruth Park but did show significance between Coffee and Curtis.

Table 6.7: ANOVA Playground (TA 5-8) Users/Observation by Cloud Cover

			Clear	Partly Cloudy	Cloudy	Misting Rain
	Frequency	n=	91	27	89	3
Mean	Coffee Park		21.6	18.8	18.3	6
	Caruth Park		14.3	10.0	11.0	1.5
	Curtis Park		10.4	8.0	8.5	12.5
ANOVA	MS Between groups		972.5	307.2	762.6	
	MS Within groups		150.0	60.6	174.9	
		F (2 d.f.)	6.48	5.07	4.36	
		p<	0.002	0.015	0.016	
Comp*	Coffee-Caruth	p<	0.078	0.067	0.109	
	Coffee-Curtis	p<	0.003	0.026	0.021	
	Caruth-Curtis	p<	0.465	0.870	0.074	
Kruskall-Wallis	Coffee	Rank Sum	1712	191	1547	
	Caruth	Rank Sum	1330	105	1265	
	Curtis	Rank Sum	1144	82.5	1193	
		Chi2 (2 d.f.)	9.07	6.552	4.67	
		p<	0.011	0.038	0.099	
	Bartlett's:	Chi2 (2 d.f.)	14.88	1.89	26.80	
		p<	0.001	0.388	0.000	

*Scheffe Multiple-Comparison Adjustment

Analysis of the temperature ranges showed a majority of the observations in the 80°F temperature range and over 70% of the observations were done in temperatures over 70°F. ANOVA analysis of observations partitioned by temperature rating at each of the parks is shown in Table 6.8. Mean numbers of users in the observations are higher at Coffee Park in all of the

temperature ranges. The two lower ranges of below 70°F have only 60 total observations and do not show statistical significance to the mean observation numbers. The observations where the temperature is over 70°F do show statistical significance in all but the multiple-comparison analysis between Coffee Park and Caruth Park which shows marginal significance. Overall these results fail to generate a significant conclusion based on temperature.

Table 6.8: ANOVA Playground (TA 5-8) Users/Observation by Temperature

			<60°F	>=60°F, <70°F	>=70°F, <80°F	>=80°F
	Frequency	n=	16	44	101	49
Mean	Coffee Park		11.8	11.1	20.3	27.4
	Caruth Park		9.3	7.4	13.6	14.8
	Curtis Park		1.3	6.5	10.5	11.8
ANOVA	MS Between groups		160.0	86.1	829.1	1195.9
	MS Within groups		118.6	96.4	159.1	125.0
		F (2 d.f.)	1.35	0.89	5.21	9.57
		p<	0.293	0.412	0.007	0.001
Comp*	Coffee-Caruth	p<	0.929	0.592	0.100	0.010
	Coffee-Curtis	p<	0.312	0.459	0.008	0.001
	Caruth-Curtis	p<	0.526	0.964	0.587	0.766
Kruskall-Wallis	Coffee	Rank Sum	57.5	335.5	1974	640
	Caruth	Rank Sum	42.0	344.5	1728	288
	Curtis	Rank Sum	36.5	310.0	1450	298
		Chi2 (2 d.f.)	0.63	0.28	7.14	15.79
		p<	0.729	0.867	0.028	0.001
	Bartlett's:	Chi2 (2 d.f.)	11.50	6.48	24.72	8.21
		p<	0.003	0.039	0.001	0.016

*Scheffe Multiple-Comparison Adjustment

Playground Users per Equipment Play Event and per Square Foot of Surfacing

One of the assumptions of the research is that the playground play areas are reasonably similar enough to allow the comparative analysis to be done with UD being the primary

independent variable. As a further test of that assumption, the Playground Zone user counts are evaluated using the same ANOVA procedures that were previously done applying two industry accepted determinates of playground size. The playground industry primarily uses the measure of numbers of play events, climbers, slides, play panels, etc., as the measure of a playground size. This is supported by the size of a playground being judged for regulatory purposes of the Federal Accessibility Standards using counts of play elements in the 2010 ADA Standards for Accessible Design (USDOJ, 2010). The secondary measure is of the size of the playground surfacing area. Each of the measures was divided by mean Playground Zone users per observation to arrive at the ratios of Users per Play Event and Users per Square Foot of playground surface to be applied in the further evaluation of the hypothesis. Results of the ANOVA analysis is shown in Table 6.9.

In an analysis of Users per Play Event, the ANOVA summary table reports Coffee Park, the Case, having 0.49 users per play event where the Comparisons, Caruth Park, and Curtis Park have nearly equal means of 0.296 and 0.302 respectively. The numbers of play events at Coffee Park having 40 play events and Caruth Park having 41 are very similar with Curtis Park having 31 play events that is considerably less than the other two playgrounds. Even with that difference, the mean users per play event is nearly 40% greater in Coffee Park, the Case, than in the Comparisons. The statistical significance of the difference in the means is strong, with F test returning a statistically significant result $F(2, 207) = 8.70$, $p<0.001$ giving support to the means being significantly unequal. The Scheffe test shows confirming results between Coffee Park and Caruth Park ($p<0.002$), and between Coffee Park and Curtis Park ($p<0.002$). The Kruskall-Wallis one-way analysis of variance that is appropriate for the non-parametric condition of the data is significant at $Chi2\ (2)\ 11.62$, $p<0.003$.

Table 6.9: ANOVA Playground (TA 5-8) Users/Observation per Play Event and per Square Foot

			Users per Play Event	Users per Square Foot
	Frequency	n=	70	70
Mean	Coffee Park		0.490	0.00306
	Caruth Park		0.296	0.00154
	Curtis Park		0.302	0.00164
ANOVA	MS Between groups		0.854	0.0000508
	MS Within groups		0.098	0.00000339
		F (2 d.f.)	8.70	15.00
		p<	0.001	0.001
Comp*	Coffee-Caruth	p<	0.002	0.001
	Coffee-Curtis	p<	0.002	0.001
	Caruth-Curtis	p<	0.995	0.946
Kruskall-Wallis	Coffee	Rank Sum	8792	9165
	Caruth	Rank Sum	6547	6260
	Curtis	Rank Sum	6817	6730
		Chi2 (2 d.f.)	11.62	18.81
		p<	0.003	0.001
	Bartlett's:	Chi2 (2 d.f.)	26.94	46.01
		p<	0.001	0.001

*Scheffe Multiple-Comparison Adjustment

Playground surfacing square footages for the three parks range from a high of 7900 square feet (s.f.) at Caruth Park to a low of 5700 s.f. at Curtis Park, the Comparisons with Coffee Park, the Case being between them at 6400 s.f.. The summary statistics show the mean users per square foot are 0.00306 at Coffee Park, 0.00154 at Caruth Park and 0.00164 at Curtis Park. Relative to each other the mean at Caruth and Curtis appear near each other and that of Coffee Park, the Case being nearly double that of the Comparisons. The F test is statistically significant $F(2, 207) = 15.00$ $p<0.001$ in support of the means being significantly unequal. The Scheffe multiple-comparison adjustment reports a statistically significant result for the comparison between Coffee and Caruth ($p<0.001$) and a significant result in the comparison between Coffee

and Curtis ($p<0.001$). The Kruskall-Wallis one-way analysis of variance is significant at Chi2 (2) 18.81, $p<0.001$.

Both variables, Users per Play Event and Users per Square Foot show similar patterns where Coffee Park, the Case, has more use per measured physical feature than do the Comparisons. The data shows statistical significance and gives support for the hypothesis when the observation data is converted to a ratio including the variables of the number of play events and users per square foot. Results of the analysis of Users per Play Event and Users per Square Foot would tend to add support for the hypothesis.

Summary

The ANOVA evaluation supports significantly higher mean use levels in the Coffee Park Playground Zones in support of the hypothesis in an environment where overall park use is significantly lower in Coffee Park, the Case, than in the Comparisons. Evaluation of the Park Zones is shown by ANOVA to have a significant inverse relationship which does not provide a confounding condition in the parks overall and adds support for the hypothesis. Analysis of weekend versus weekday use, use during the different observation time periods, and the two weather variables of cloud cover and temperature have less strength but also show overall support. A final analysis combining physical measures of playground size adds strong support to the hypothesis.

Further evaluation will be explored using bivariate analysis and negative binomial regression. It will be evaluated for regressing the independent variable against the moderator variables for each park and between parks to evaluate the effect of the covariates versus the independent variable (Colabianchi, et al., 2011). The high overdispersion of the data gives preliminary support to the use of negative binomial regression modeling as opposed to Poisson

regression modeling. The high incidence of zeros in the observations would suggest the need to use zero-inflated count modeling. Testing will be done to determine if Poisson regression or negative binomial regression has the best fit, then further testing will be done to evaluate the fit of zero-inflated count models.

6.1.3 Multivariate Analysis

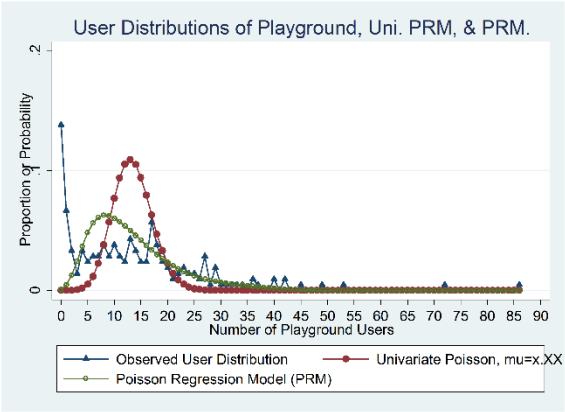
Application of ANOVA to the variables of the data have demonstrated the statistical significance of the relationships between the independent variable of UD and the dependent variable of use in the Playground Zones (TA 5-8). Multivariate analysis will account for the magnitude of the effects the mediator variables of weekend/weekday, time period, temperature, and weather, and the primary independent variable, UD, have on the dependent variable of playground use. While linear regression models could be used for count variables, models designed for count outcomes are generally more efficient and consistent.

There are several models available including Poisson Regression Model (PRM), Negative Binomial Regression Model (NBRM) and their variants which will be analyzed to establish the most appropriate model. In cases where the variance of the mean exceeds the standard deviation, there is likely over-dispersion of the count variables, NBRM should be applied (Long & Freese, 2014). A variant that is available in both PRM and NBRM to model for an excess of zeros is to use a Zero-Inflated model (Cameron & Trivedi, 2013). These models will be evaluated for use with the data.

The dependent variable, playground users (pgndusers) is generated for each of the 70 observation time periods in the Playground Zones (TA 5-8) of each park as the result of averaging the two observation rotations done in each period. This results in either an integer or a combination of an integer and a half (for example 27.5). Poisson regression as a count model

requires an integer as the dependent variable (Cameron & Trivedi, 2013). A new dependent variable having all values of the variable converted to integers by dropping the decimal value (27.5 becomes 27) will be created for the regressions (Stata command: gen pgusr_int = pgndusers).

When evaluating the available models appropriate for count variables, sound practice is considered to be evaluating each of the models in sequence (Cameron & Trivedi, 2013). The PRM was run with the dependent variable in two conditions, first in a univariate condition with only the dependent variable, playground use, and the independent variable, UD. Then the mediator variables of weekend/weekday, time period, temperature, and cloud cover were added to the PRM. These models were graphed along with the actual observed user distribution. Goodness of fit is evaluated graphically as shown in Figure 6.2.



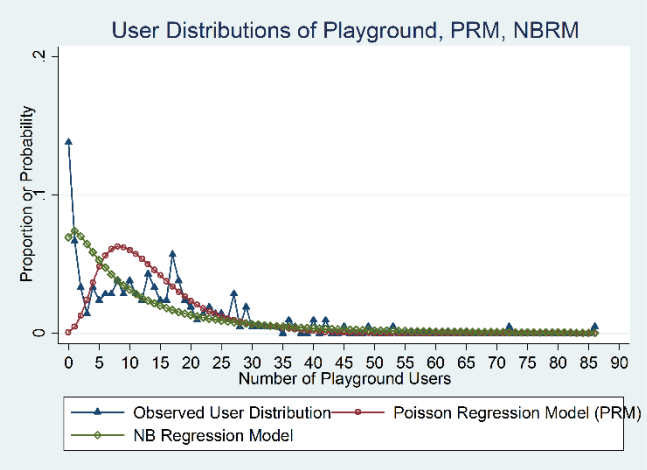
Mean – 13.69; SD - 12.83; Variance - 164.60

Figure 6.2: Observed Playground Users, Univariate Poisson, and PRM

The graph shows the observed user distribution having an excessive number of zeros in comparison with the other count numbers and also having a non-parametric and overdispersed

distribution curve. This is shown against the univariate PRM using only the independent variable UD regressed against the dependent variable playground users and the full PRM with the dependent variable regressed against the independent variable and the mediator variables. In the graph, the multivariate curve shows the better fit although it does vary from the observed distribution.

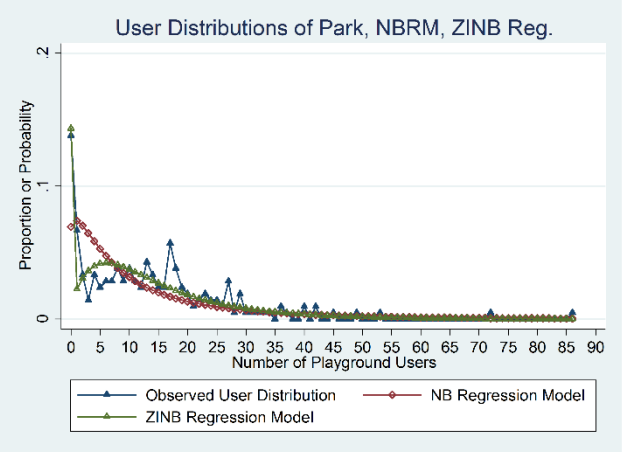
In cases where the count data exhibits overdispersion, the PRM estimates can be inefficient having standard errors with a downward bias. Overdispersion is generally considered evident when the variance exceeds the standard deviation. This condition is exhibited strongly in the data presented in Table 6.2 where the variance is from 7 to 17 times the standard deviation in the playground zones of the three parks. In cases of overdispersion, there is a considerable risk of Type 1 error. In these cases, NBRM often returns preferable results over PRM and the estimates are commonly compared side by side. Graphs of the PRM and NBRM model are shown in Figure 6.3 (Long & Freese, 2014).



Mean – 13.69; SD - 12.83; Variance - 164.60

Figure 6.3: Observed Playground Users, PRM, and NB Regression Model (NBRM)

The graphs of the model estimates show the observed users and the PRM estimate along with the NBRM estimates. The NBRM shows a better fit than the PRM in comparison with the Observed User Distribution. With count data that has a large number of zeros in the observations, the models result in an underprediction of zeros which has been accounted for by use of zero-inflated models, or Zero Inflated Negative Binomial Regression Models (ZINB). Estimates from the NBRM and ZINB are graphed along with the Observed Distribution in Figure 6.4 showing the closest fit being with the ZINB model (Long & Freese, 2014).



Mean – 13.69; SD - 12.83; Variance - 164.60

Figure 6.4: Observed Playground Users, NBRM, and ZINB

To confirm the graphic representation of the fit of the models, Stata has automated the process with the "countfit" command. Countfit provides a simultaneous comparison of PRM, NBRM, and ZINB with the addition of Zero Inflate Poisson (ZIP) that wasn't compared herein. An abbreviated table of the results is shown in Table 6.10 where PRM, NBRM, and ZINB results are reported, full output is shown in the Appendix Table 6.10a (Long & Freese, 2014).

Table 6.10: Stata "countfit" Test and Fit Statistics

PRM	BIC=	2528.535	AIC=	2508.452	Prefer	Over	Evidence
vs NBRM	BIC=	1491.111	dif=	1037.423	NBRM	PRM	Very strong
	AIC=	1467.682	dif=	1040.770	NBRM	PRM	
	LRX2=	1042.770	prob=	0.000	NBRM	PRM	p=0.000
NBRM	BIC=	1491.111	AIC=	1467.682	Prefer	Over	Evidence
vs ZINB	BIC=	1424.613	dif=	66.499	ZINB	NBRM	Very strong
	AIC=	1381.100	dif=	86.581	ZINB	NBRM	
	Vuong=	4.063	prob=	0.000	ZINB	NBRM	p=0.000

The primary measures of fit used by "countfit" are Akaike's Information Criteria (AIC) and Bayesian Information Criteria (BIC) as reported in the table for PRM vs NBRM and for NBRM vs ZINB. A better fit between models is evidenced by the lower AIC or BIC. In the case of PRM vs NBRM, NBRM shows Very Strong preference as the model of choice. In the case of NBRM vs ZINB, ZINB shows Very Strong preference as the model of choice. The Vuong statistic confirms the choice of ZINB with a significance of $p<0.001$. These quantitative tests confirm the graphic output of the figures and give validity to the ZINB regression model (Long & Freese, 2014).

The regression model is run on the dependent variable of playground users with the independent variable, UD, and the control variables of weekend, time period, temperature, cloud cover. The output is shown as a result of the "listcoef" command in Stata and is reported in terms of the raw coefficient, the z-score, significance, and percent change in each of the mediator variables as shown in Table 6.11. The table lists each of the variables run against the dependent variable. The independent variable is listed first, then the four control variables. Of the variables, only temperature does not meet the $p<0.05$ significance levels.

Table 6.11: ZINB Regression: Percentage Change Independent and Control Variables

	b	z	P>|z|	%	%StdX	SDofX
UD	0.6102	5.503	0.000	84.1	33.4	0.473
weekend	0.3386	2.840	0.005	40.3	16.6	0.453
time period	0.1252	2.319	0.020	13.3	19.4	1.418
temperature	0.1462	1.868	0.062	15.7	13.4	0.857
cloud cover	-0.1684	-2.860	0.004	-15.5	-14.9	0.958
constant	-7.6628	-4.495	0.000	.	.	.

b = raw coefficient; z = z-score for test of b=0; P>|z| = p-value for z-test;
% = percent change in expected count for unit increase in X
%StdX = percent change in expected count for SD increase in X, SDofX = standard deviation of X

The independent variable is reported to have the greatest impact on the dependent variable with a reported 84.1% positive change in the dependent variable when UD is present in the playground environment having a very strong significance of $p<0.001$. The next highest effect is for the weekend where weekend use is attributed to have a 40.3% increase in the dependent variable use with a strong significance level of $p<0.01$. The variables of time period and temperature show positive effects in the mid teens and cloud cover also being in the mid teens but negative based on the higher scales being cloudier. Time period and cloud cover are significant at the $p<0.05$ level, temperature is marginally significant at the $p<0.10$ level.

6.1.4 Multivariate Analysis of Confounding Variables

Multivariate analysis will seek to evaluate for latent effects the moderator variables have on the dependent variable of playground use in the Playground Zones (TA 5-8), that have been assumed to be controlled but may have a confounding effect with respect to the primary independent variable, UD. The variables being analyzed were previously identified in Section 5

Methods, Table 5.3. They represent other physical features in the park and playground environment that could reasonably have an effect on use. These moderator variables are taken from each of the two Zones, the Park Zone and the Playground Zone in the Case and the Comparison parks that are the subject of the observations.

Of these variables, Shelter Structure, will be treated in the qualitative analysis. Four other variables, Toilets, Drinking Fountains, Playground on Walking Trail, and Public Use Athletic Facilities were all present or in close proximity whose effects are considered to be neutral. These remaining ten variables, five from each Zone are presented with their descriptive statistics in Table 6.12. Three of the variables are measurements in feet and square feet which have been reduced by a factor of 100. This was done to make the regression statistics more meaningful as the effect per count of 100 carries more significance and is more relevant than the effect per each foot.

Table 6.12: Physical Features Inventory per Park: Park and Playground Zones

					Descriptive Statistics	
		Case	Comparisons			Standard
var	Variable	Coffee	Caruth	Curtis	Mean	Deviation
pkac	Park Acreage	4.3	7.1	9.5	7.0	2.13
pktrlc	Length of Park Trail (100 ft.)	14.4	14.0	20.8	16.4	3.12
pkcan	Park Tree Canopy Coverage (%)	34	36	44	38.0	4.33
pkwtr	Park Water Area (%)	0	13	12	8.33	5.92
pkpkg	Parking-TOTAL	46	44	72	54	12.78
pgsfc	Playground Surface s.f. (100)	64	79	57	66.7	9.18
pgesfc	Playground Environment s.f. (100)	188	238	318	248.0	53.54
plyevnt	Play Events	40	41	31	37.7	4.04
pgbnch	Benches-Playground	5	15	5	8.33	4.73
pgtbl	Picnic Tables-Playground	6	6	3	5.0	1.42

These variables will be added to the regression using the same previously validated ZINB regression model, using the dependent, independent and control variables presented previously in Table 6.11 along with these new physical feature variables. When these ten variables were regressed as a group, Stata returned a value for the first variable in the sequence but dropped the last nine because of collinearity problems. These problems are a result of the variables in Table 6.11 having 210 observations (n=210), each observation having a unique value of the variable, the physical feature moderator variables are unique to the parks as a whole which number 3, and therefore have an n = 3. This being the case, all 70 of the observations in each park will have the same value for these variables. When these variables were run in sequence with the control variables there was a modest change to the control values reported. The new control values were constant through each of the ten regressions and are therefore considered controlled in these regressions.

Control variables were run with the physical feature variables and tabulated first in the Park Zone in Table 6.13, then secondly in the Playground Zone as shown in Table 6.14. The physical feature (confounding) variables are run with the control variables which remained the same and whose values also remained the same for all runs. Reported are the percent change per unit change for the independent variable UD along with the percent change per unit change for each variable and the significance level for each.

Table 6.13: ZINB Regression: Physical Features – Park Zone

	variable	b	z	P>|z|	%	%StdX	SDofX
Park Acreage	UD	-0.004	-0.017	0.986	-0.4	-0.2	0.473
	pkac	-0.156	-2.885	0.004	-14.4	-28.3	2.130
Park Trail Length (100)	UD	0.455	3.696	0.000	57.6	24.0	0.473
	pktrlc	-0.055	-0.2885	0.004	-5.4	-15.8	3.123
Percent Tree Canopy	UD	0.339	2.320	0.020	40.4	17.4	0.473
	pkcan	-0.047	-2.885	0.004	-4.6	-18.3	4.331
Percent Water	UD	5.299	3.261	0.001	19918.5	1132.2	0.473
	pkwtr	0.374	2.885	0.004	45.4	817.5	5.921
Parking Spaces	UD	0.459	3.758	0.000	58.3	24.2	0.473
	pkpkg	-0.0134	-2.885	0.004	-1.3	-15.7	12.785

b = raw coefficient; z = z-score for test of b=0; P>|z| = p-value for z-test;
% = percent change in expected count for unit increase in X
%StdX = percent change in expected count for SD increase in X, SDofX = standard deviation of X
All Models controlled for variables in Table 5.17

In the Park Zone, the independent variable UD is insignificant in a model with the variable Park Acreage. All other models show UD being greatly more dominant in having a much higher percentage of effect on the outcome than the control variables. All remaining statistics are significant at the $p<0.05$ level and all except for UD with respect to Percent Tree Canopy are significant at the $p<0.01$ level. In all of the models, the effect of UD considerably outweighs the effect the physical park feature variable has on the dependent variable of use in the playground environment.

Table 6.14: ZINB Regression: Physical Features – Playground Zone

	variable	b	z	P>|z|	%	%StdX	SDofX
Playground Surface s.f. (100)	UD	0.689	6.193	0.000	98.9	38.4	0.473
	pgsfc	0.017	2.885	0.004	1.7	16.9	9.199
Playground Environment s.f. (100)	UD	0.199	1.089	0.276	22.0	9.8	0.473
	pgesfc	-0.005	-2.885	0.004	-0.5	-22.2	53.669
Play Events	UD	0.474	3.953	0.000	60.7	25.1	0.473
	plyevnt	0.042	2.885	0.004	4.2	18.3	4.037
Benches-Playground	UD	0.807	6.389	0.000	124.1	46.4	0.473
	pgbnch	0.037	2.885	0.004	3.8	19.4	4.725
Picnic Tables-Playground	UD	0.433	3.413	0.001	54.1	22.7	0.473
	pgtbl	0.125	2.885	0.004	13.3	19.4	1.418

b = raw coefficient; z = z-score for test of b=0; P>|z| = p-value for z-test;
% = percent change in expected count for unit increase in X
%StdX = percent change in expected count for SD increase in X, SDofX = standard deviation of X
All Models controlled for variables in Table 5.17

In the Playground Zone, the variable of playground environment square footage was not statistically significant for the independent variable UD. All of the other variables in the regressions had statistically significant returns. The relationship between the effects on the dependent variable of playground use between the variables is the highest between UD and Picnic Tables where statistically the presence of picnic tables has the highest degree of influence on use among the control variables. In the case of all the significant variables, UD is expressed as the dominant contributor affecting the dependent variable, playground use.

6.2 Secondary Aims

Evaluation of the secondary aims will take advantage of the graphic format of the data collection. It will make descriptive analysis of use and physical activity levels relative to specific amenities or affordances. The evaluation will also include a graphic presentation of the

overall use during a representative day in each of the overall park and specific playground environments showing where users tend to congregate.

6.2.1 Use of Affordances

Conduct exploratory behavior mapping research in the Case and two Comparison parks evaluating where the use is taking place in the park and play environments relative to specific physical elements. Locations of participants are used to evaluate percentages of use in each behavior setting area. The ranking of use levels among the different affordances within the areas show an indication of attractiveness among the physical features making up the park and playground environments (Moore & Cosco, 2007). Beyond the primary hypothesis, detail of the data has the potential of lending itself to exploring park use in a qualitative sense based on how people are using the features of the park.

Identification and analysis of park features centers on the concept of affordance which is the type of activity a physical element supports or affords (Gibson, 1979). These affordances are sometimes spread throughout the parks and sometimes they are concentrated in specific areas. These places and areas in which use is influenced by a physical element or class of physical elements can be thought of as behavior settings (Moore & Cosco, 2007). There are eight categories of affordances that have consistency across the parks which were translated into behavior settings. Use in the behavior settings was then extracted from the data in terms of child versus nonchild and active versus sedentary as was done in the previous analysis.

Users by Affordance Based Behavior Setting

Of the eight behavior settings, two of the typologies were shared across the Park and Playground Zones but they were separately categorized by their respective Zone. These settings

were Gathering Areas which is general open space around the park and playground areas, and then Site Furnishings which is where either a park bench or picnic table is used for gathering and resting. Unique to the Park Zones were the behavior settings of Sports Areas where organized sports activities with rules are programmed to be held and Park Trails that are used by walkers and joggers. Within the Playground Zones are the settings of the Play Structure, the Swings, and the Play Surface, all in the active play area. A single category of Shelter is included as a division of the Playground Zone Gathering Areas to evaluate use levels of the shelter found only in the playground environment in Coffee Park, the Case, for possible confounding effects.

From the perspective of the research hypothesis, the purpose of analysis of use in the shelter area is to evaluate the degree to which the shelter, which is located only in the environs of the Coffee Park playground, influences use. This shelter is the only park shelter among the Case and Comparison parks and playgrounds, and with its location adjacent to the playground in the Case condition, it could be a confounding element to the research findings. The data in terms of use by affordance will be used to explore the contribution of varying park elements to active living and outdoor physical activity. The numbers of users for each affordance behavior setting, including the shelter is shown by park in Table 6.15.

The data shows the shelter at Coffee Park had 44 users recorded under it which are 0.7% of the total users recorded in all of the parks and 2.1% of the users recorded at Coffee Park. It has the lowest use of all the use categories of the combined data from all the parks and among the three individual parks is only higher than the numbers of people using the Park Furnishings in the Park Zone of Coffee Park. There are over five times the number of people using the Park Furnishings in Coffee Park Playground Zone than those using the shelter. This relatively low number of users under the shelter would suggest that the shelter is not a confounding element to

the data and does not appear to give support to its being a significant reason for the higher use in the Coffee Park Playground Zone.

The Park Zones show the largest amount of their use in the Active Sports Areas that afford space for organized sports games, usually large group activities. Over 25% of total park use comes from people participating in or observing organized sports. Gathering Areas in the Park Zones have the next greatest use with nearly 15% overall. In Curtis Park over 22% of park use is found in the Gathering Areas where less than 7% of park use is found in these areas in Coffee Park, the Case. Trails account for nearly 10% of the use. Site Furnishings such as picnic tables and park benches, which have been demonstrated to be important especially for the older segment of the population, show the lowest use of just over 2% overall (Rodiek & Fried, 2005). Consistent with earlier evaluations, Coffee Park has lower numbers of users in the Park Zones than does Caruth Park and Curtis Park.

Table 6.15: Users/Observation by Affordance in the Park and Playground Zones

	COMBINED (n=210)		COFFEE (Case) (n=70)		CARUTH (Comparison) (n=70)		CURTIS (Comparison) (n=70)	
	Users	%*	Users	%*	Users	%*	Users	%*
ENTIRE PARK (TA 1-8)	29.81		29.85		31.56		28.02	
PARK ZONES (TA 1-4)								
Gathering Areas	4.30	14.4%	1.91	6.4%	4.67	14.8%	6.32	22.6%
Site Furnishings	0.66	2.2%	0.21	0.7%	0.77	2.4%	1.01	3.6%
Active Sports Areas	8.30	27.9%	7.20	24.1%	10.45	33.1%	7.26	25.9%
Trails	2.85	9.6%	0.94	3.1%	3.53	11.2%	4.09	14.6%
PLAYGROUND ZONES (TA 5-8)								
Gathering Areas	2.38	8.0%	2.93	9.8%	2.41	7.7%	1.80	6.4%
Site Furnishings	2.41	8.1%	3.48	11.7%	1.95	6.2%	1.81	6.5%
Shelter	0.21	0.7%	0.63	2.1%	0.00	0.0%	0.00	0.0%
Play Structure	2.84	9.5%	4.84	16.2%	2.36	7.5%	1.31	4.7%
Swings	1.93	6.5%	2.36	7.9%	1.91	6.1%	1.51	5.4%
Play Surfacing	3.92	13.2%	5.36	18.0%	3.49	11.1%	2.91	10.4%

* Users by Affordance as a percent of total park users

In the Playground Zones of each of the parks, the highest use area is the playground surfacing located in and around all of the constructed play elements (play structure and swing). Overall, over 13% of the users were on the surfacing alone with Coffee Park having the highest proportion at 18%. The next highest use setting is the play structure itself with 9.5% of the overall users and 16.2% of the users at Coffee Park. It is interesting to note that the play structure use levels at Coffee Park in both total users and percent of overall park users are over twice that in either of the Comparisons, Caruth Park or Curtis Park.

Combined use of the Playground Zone Gathering Areas and of the Site Furnishings is nearly the same overall as that in the Park Zone except that the proportionate use of the Gathering Area is much greater in the Park Zone and use of the Site Furnishings is greatly reduced. Overall there are 8% of the park users using the Playground Zone Gathering Areas and another 8.1% using the Site Furnishings in comparison with 14.4% and 2.2% respectively in the Park Zones. Consistent with the previous findings, use of these areas at Coffee Park is greater than either Caruth Park or Curtis Park.

The descriptive analysis is graphically depicted in the following bar chart, Figure 6.5. The first four variables along the X axis are in the Park Zones (TA 1-4). The last six variables are in the Playground Zones (TA 5-8). The bar chart depicts the percentage of users observed in the setting as a percentage of the users in all of the settings of the category.

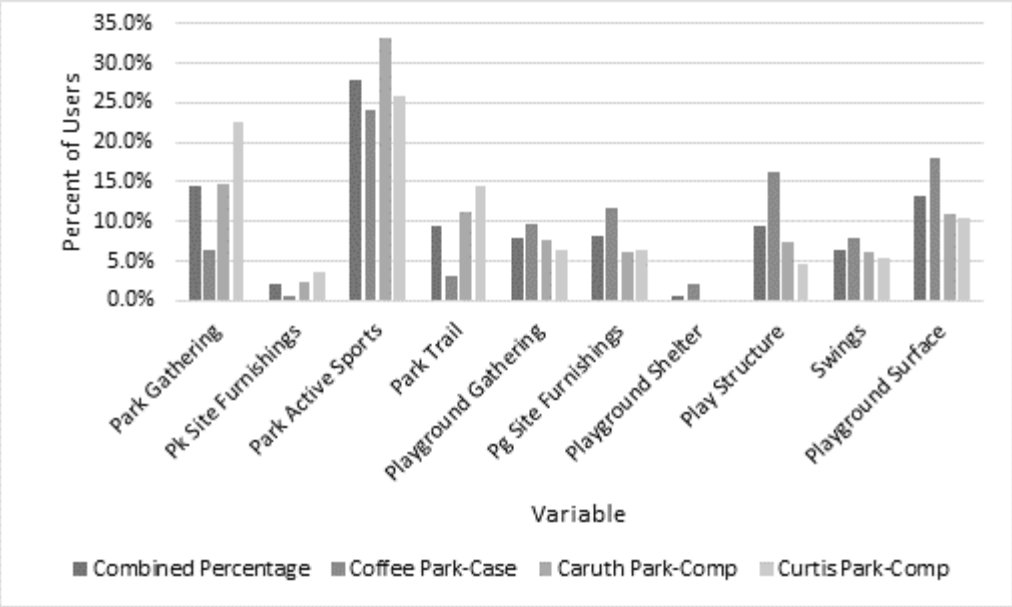


Figure 6.5: Percent of Users by Affordance Behavior Setting per Park

There are four bars shown, first is the Combined Mean which is the combined average of the three parks for each variable shown in black. Next, are the three parks, first Coffee Park, the Case shown in the darkest level of gray, then the two Comparisons, Caruth Park, and Curtis Park are shown in descending levels of gray. The chart shows Coffee Park having lower percentages of activity than the mean in the Park Zones and higher levels of activity than the mean in the Playground Zones. Active Sports in the Park Zones has the highest percent of use with Coffee Park once again having the lowest percent use for this variable among each of the other parks and of the combined total.

Playground use at Coffee Park is considerably higher in all of the categories. It shows the greatest degree of difference in the Play Structure and Playground Surface settings with the Playground Surfacing actually showing a higher percent of use than the Play Structure.

Rank by Affordance Based Behavior Setting

The question of which behavior setting attracts the most users has the potential to impact park development decision making on a practical scale. This decision making can, in turn, affect overall park use and a park's contribution to raising physical activity levels in a community. Graphic presentation of the observers reported as a combined total and in each park, partitioned by Park Zone and Playground Zone is shown in Figure 6.6 to establish a beginning reference for the rank analysis. The figure shows a greater percentage of use in the Park Zones than use in the Playground Zones in all of the parks and the combined total except for in Coffee Park, the Case, where there is greater use in the Playground Zone.

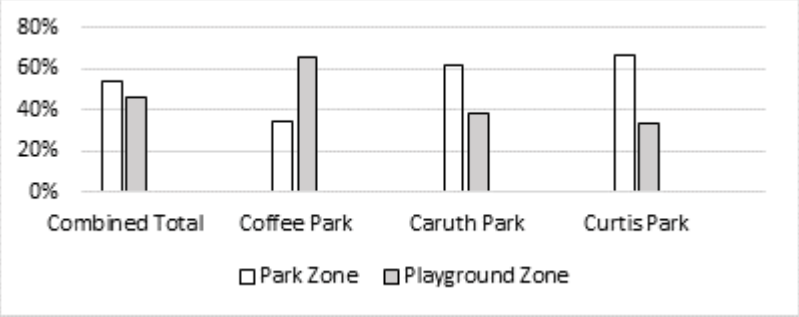


Figure 6.6: Percent of Users by Park per Park or Playground Zone

The contribution different park affordances make to the attractiveness of a park environment may be evaluated from a variety of dimensions applying the concept of revealed preferences expressed by behavior. Affordance use levels and rank ordering of those levels has been used as a component of attractiveness in the process of evaluating the contribution different park elements and areas make toward engaging people in the park environment (Moore & Cosco, 2007). This study will evaluate the levels of use by affordance behavior setting as an

overall function of the three parks combined and individually by park. The behavior settings, their rank orderings, and percent use are presented graphically for the combined total and each park individually in the four graphs of Figure 6.7. The bar graphs differentiate between the Park Zones and the Playground Zones using a gray fill for the Playground Zones.

The programmed Active Sports areas receive the largest levels of park use in all of the parks and in the combined total by a considerable margin. These areas had scheduled activities of youth soccer, flag football, little league baseball, and structured tennis lessons with a trained coach. Accompanying the sports areas as next highest use area in the Combined condition and in the two Comparison Parks is the Park Gathering Areas. This can be easily rationalized with the understanding that many of the spectators of the sports events are viewing from the adjoining Gathering Areas. Coffee Park had the lowest level of use in the Active Sports Areas and had less spill over from the scheduled activities into the adjacent gathering areas.

Activity in the Park Trail areas was the fourth highest use area for the combined total and the third highest for the Comparisons. The trail areas had nearly 10% of the park use in the Combined Total and 11.2% and 14.6% in Caruth and Curtis parks respectively. In Coffee Park, trail use was one of the lowest uses with 3.1% of park use on the trail. This is not easily rationalized except to think that Coffee Park is both the smallest of the parks and with no water feature, possibly the least attractive of the parks for walking. There were also 480 dogs recorded in the park observations, many of which were observed being walking or running companions on the trails.

The Park Site Furnishings areas which are the park benches and picnic tables were among the least used areas of the parks. While research shows the importance of park benches for resting, especially for people with disabilities and other challenges (Rodiek & Lee, 2009), their recorded use levels in this research were quite low. Except for the Playground Shelter area

which is only found in the Coffee Park playground area, and which saw only 44 total users, use of the Site Furnishings was the lowest use affordance with 2-3% of the recorded use being attributed to them. While their demonstrated use is low, their value is well supported by research in accommodating the needs of people with disabilities and other frailties and also to create an overall welcoming and accommodating park environment.

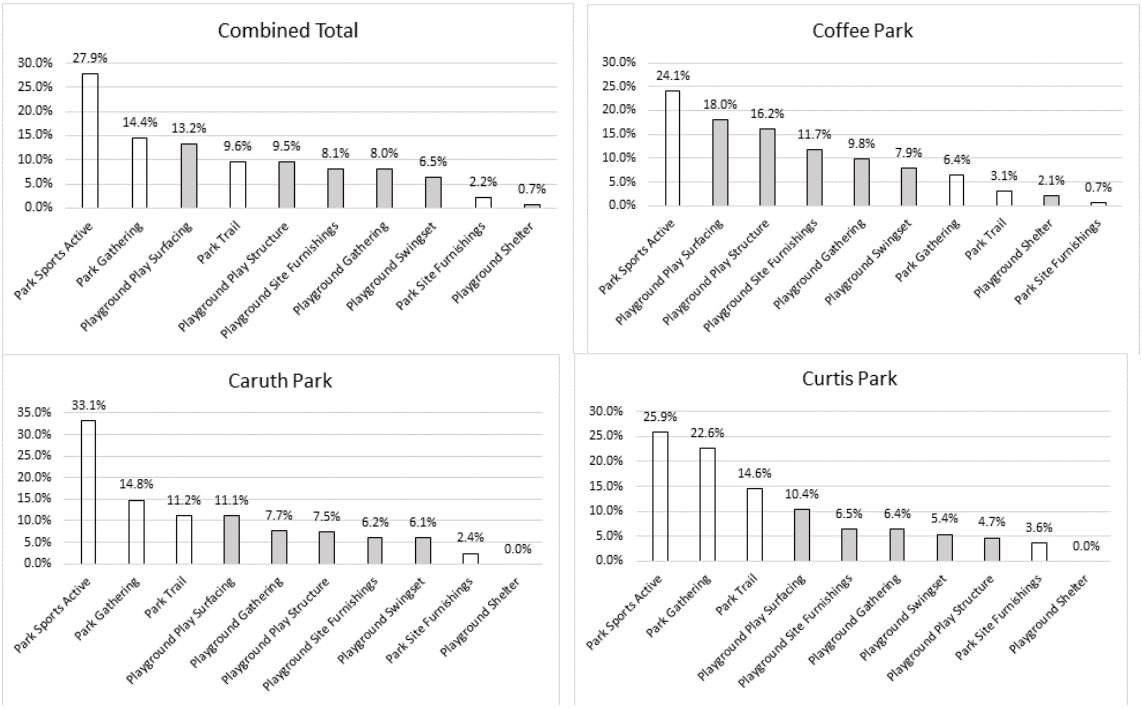


Figure 6.7: Rank of Use by Affordance Behavior Setting: Combined Total; Coffee Park, Case; Caruth and Curtis Parks, Comparisons

Of the playground areas, the Playground Play Surfacing areas had the greatest level of use. These areas were the most highly used areas in the Playground Zone across all of the parks being the only areas that received more than 10% of the park use in all of the parks. It was ranked fourth in both of the comparisons but ranked second only behind the Active Sports areas

in Coffee Park. The Playground Play Surfacing areas also received more use than the play structures themselves. Recent renovations in the Comparison Parks replacing the loose fill engineered wood fiber surfacing with unitary poured in place rubber surfacing to match that at the Case playground is likely to have had a positive effect on playground use in these parks.

The Playground Play Structure ranked 5th with 9.5% of the overall park use in the Combined Total and had 16.2% of the use at Coffee Park, the Case. This high percentage of use is clearly a contributor to the high use in the Playground Zone of Coffee Park, although the other Playground Zone affordance areas also saw higher use levels in Coffee Park. In Caruth Park, the Playground Play Structure ranked 6th with 7.5% of the park use, less than half that at Coffee, and was ranked 8th at Curtis Park with 4.7% of the use.

In the Playground Zones, the Playground Site Furnishings, or benches and picnic tables, received much more use than in the Park Zones. In the Combined Total, the Playground Site Furnishings ranked 6th with 8.1% of the use which is nearly four times the use received by the Park Site Furnishings. They received the highest levels of use at Coffee Park with 11.7% and were in the 6% range for the Comparison Parks. Most of the use was by caregivers of the children using the playground areas, often in the accompaniment of a younger sibling that was still in a stroller (children in strollers were accounted for but were tallied along with their caregiver and did not add to the user totals).

The Playground Gathering Areas were composed of the sidewalk and small areas of grass around the playground area at Coffee Park and the larger grassy and paved areas around Caruth and Curtis Parks. The Gathering Areas at both Caruth Park and Curtis Park were bordered by the park water feature on the side opposite the playground and were considerably larger than in Coffee Park. Not all of the use in these gathering areas was clearly attributable to the playground activity but the use was cataloged in that fashion to avoid questions about

inappropriately deleting viable use areas from the comparisons to assist in support for the hypothesis. Use levels in the Playground Gathering Areas was ranked 7th in the Combined Totals at 8.0% of use. It gathered 9.8% of the use at Coffee Park, 7.7% of the use at Caruth Park, and 6.4% of the use at Curtis Park.

Of the Playground Zone areas, the least used in terms of numbers of users was the Swingset area. This is understandable because of the finite capacity of a swingset. The swing capacity for Coffee Park is 4 swings, and there are 6 swings at Caruth and Curtis Parks. In each of the three parks, two of the swings are molded child/infant swings. Even with this low finite capacity use of the swings is consistent and between a high of 7.9% at Coffee and 5.4% at Curtis. This makes the swings the lowest ranked play element but they do get consistent use.

These results were mostly expected with a couple of exceptions. Having been around these play areas, the low use of the shelter in the Coffee Park play area came as no surprise but in other environments and in the literature, park shelters are generally considered to have a greater contribution to overall use (Moore & Cosco, 2007). The most unexpected result was the amount of use on the playground surfacing being greater than that of the play structure itself. This should not discount the structure as the main attraction that brings children and families to the playground but it can highlight the impact the surfacing and other ancillary features have on a playground. It could serve to call attention to the importance of considering the play environment as a whole rather than simply giving most of the focus to the play structure and treating the rest of the environment as an afterthought.

Child/NonChild Ratio by Affordance Based Behavior Setting

Another dimension of affordance analysis is to identify and differentiate elements that are used more by children. The mapping format used for data gathering lends itself well to this

type of analysis. Users were recorded as child and nonchild with two separate age levels of child, preschool, and school age, and two levels of nonchild being teen and adult. With the low numbers of teens recorded, especially in the playground areas, this data lends itself well to research using child/adult ratios (CAR). These ratios are a quick way to differentiate between adult dominated environments and child dominated environments. A CAR of over 1.00 indicates more children than adults and conversely a CAR of less than 1.00 indicates more adults than children (Moore & Cosco, 2007). The CAR, or for this research the Child/Nonchild Ratios (CNR) are reported in Table 6.16.

Overall, the parks are dominated by NonChild users with a combined CNR of 0.88. Of the parks, Coffee Park is the only one having a CNR over 1.00 with Caruth and Curtis being significantly lower at 0.80 and 0.71 respectively. All of the Park Zones with the exception of the Active Sports Area at Coffee Park have children as minority participants. High adult participation in the programmed sports areas does speak well of parent support in childhood sports activities which is a significant contribution to the healthy upbringing of children. The CNR for Site Furnishings are all in the lower third and Trail use is nearly so reflecting high proportions of adult use in these areas.

In the Playground Zones, Coffee Park has the highest CNR at 1.46 although all of the parks in the study have a CNR of well over 1.00. The Site Furnishings in the Playground Zones are still strongly dominated by nonchild participation as can be expected. The Swings and Play Surfacing areas both show CNRs higher than the overall for the Playground Zones indicating higher levels of child participation. In the case of the Playground Structure, the Combined CNR is quite high at 7.22 indicating over seven times the children using the play structure as are adults. A finding that is understandable but also unexpected is that Coffee Park has as the lowest Play Structure CNR of any of the parks at 6.28. That is nearly a point and 13% below the

Combined number and less than the other parks by greater measure. One possible explanation could be the thought that the ramps on the play structure give parents easier access and therefore a greater ability to get onto the structure to play with their children.

Table 6.16: Child/NonChild Ratio (CNR) by Affordance in the Park and Playground Zones

	COMBINED (n=210) CNR	COFFEE (Case) (n=70) CNR	CARUTH (Comparison) (n=70) CNR	CURTIS (Comparison) (n=70) CNR
TOTAL USERS (TA 1-8)	0.88	1.19	0.80	0.71
PARK ZONES (TA 1-4)	0.62	0.82	0.60	0.54
Gathering Areas	0.66	0.63	0.81	0.57
Site Furnishings	0.16	0.32	0.21	0.10
Active Sports Areas	0.79	1.03	0.71	0.70
Trails	0.32	0.21	0.25	0.41
PLAYGROUND ZONES (TA 5-8)	1.33	1.46	1.25	1.19
Gathering Areas	1.06	1.32	0.84	1.03
Site Furnishings	0.27	0.31	0.23	0.25
Shelter	0.47	0.47	0.00	0.00
Play Structure	7.22	6.28	7.95	11.27
Swings	1.69	1.80	1.85	1.37
Play Surfacing	1.43	1.54	1.25	1.46

Analysis of the Child/NonChild ratios in the two Zones and in the behavior settings can contribute to an understanding of areas in the park that are frequented by children, those dominated by nonchildren or predominantly adults, and areas where there is interaction. The findings of a lower Child/NonChild ratio on the Case play structure adds support for the hypothesis from the qualitative dimension of attracting and involving a more diverse population in play. These qualitative findings likely represent only a portion of the information further analysis may glean from the data.

Behavior Mapping

Behavior mapping was done by translating the raw data into categories of child and nonchild, then active and passive. The data was recorded graphically on a plan showing park users in their observed location along with their age category, gender, and physical activity level during a representative day that had totals near the mean for each of the three parks. Graphic presentation of the data collection on a representative day has been compiled for all observations, during all of the observation times, on plans of each Park Zone and Playground Zone for each of the three parks. Figures 6.8 and 6.9 show the Park Zones and the Playground Zones in each of the three parks respectively. The maps are presented in the full-page format in APPENDIX FIVE. The behavior maps present behavior patterns represented by the expressed preference of the space the user chose to occupy at the time of the observation. The graphic representation is put forward in the form of Child versus NonChild using circular and square symbols respectively, and Active versus Sedentary are differentiated by a gray fill in the Active symbols.

Graphic presentation of behaviors in the Park Zones shows clear patterns of use focused around the areas built and maintained to support programmed active sports events like soccer, flag football, little league baseball, and tennis. These areas have a mixture of active and sedentary users represented by participants and observers. Park users watching the child sporting events were commonly observed watching from adjacent spaces often being Gathering Areas from which they could easily see the event. Widely dispersed use can also be seen on the trails where most of the users are active.

Generally, the Park Zones are dominated by NonChild users with the Gathering Affordances and the Trails having a strong dominance of NonChild users. An explanation could be made with an understanding that children, with their more highly active behavior patterns,

have a lower need for both resting areas and dedicated paths for walking or jogging in the conscious pursuit of exercise. In the Gathering Areas, there is moderate NonChild dominance with the Active Sports Areas approaching a more balanced state. These patterns are within those that could be anticipated as children have a tendency to prefer free range active behaviors rather than sedentary activities.

In the shelter area at Coffee Park, there are only five users, all NonChild versus nearly six times that use level on the picnic tables and the single park bench. This shows the importance of seating in the playground areas and gives further illustration of the shelter being an unlikely source of confounding influence to the hypothesis with its low use level. The pattern of the picnic table and park bench use is similarly high in the two comparison parks as it is in Coffee Park identifying the contribution of affordances for sitting and gathering in the playground environment. Understandably, the use of these affordances is sedentary. In the accompanying gathering areas, there is a mix between active and sedentary use as some of the users are circulating and others are stationary.

There are nodes of activity around the swings at all of the parks and on the spiral slides of the play structures that have them. Also, the ground level climbing elements received heavy use at Coffee Park and to a somewhat lesser degree at Caruth and Curtis Parks where they are available. In all of the parks, the site furnishings of park benches and picnic tables are well used in the playground zones in contrast with those affordances out in the Park Zones which receive low levels of use.

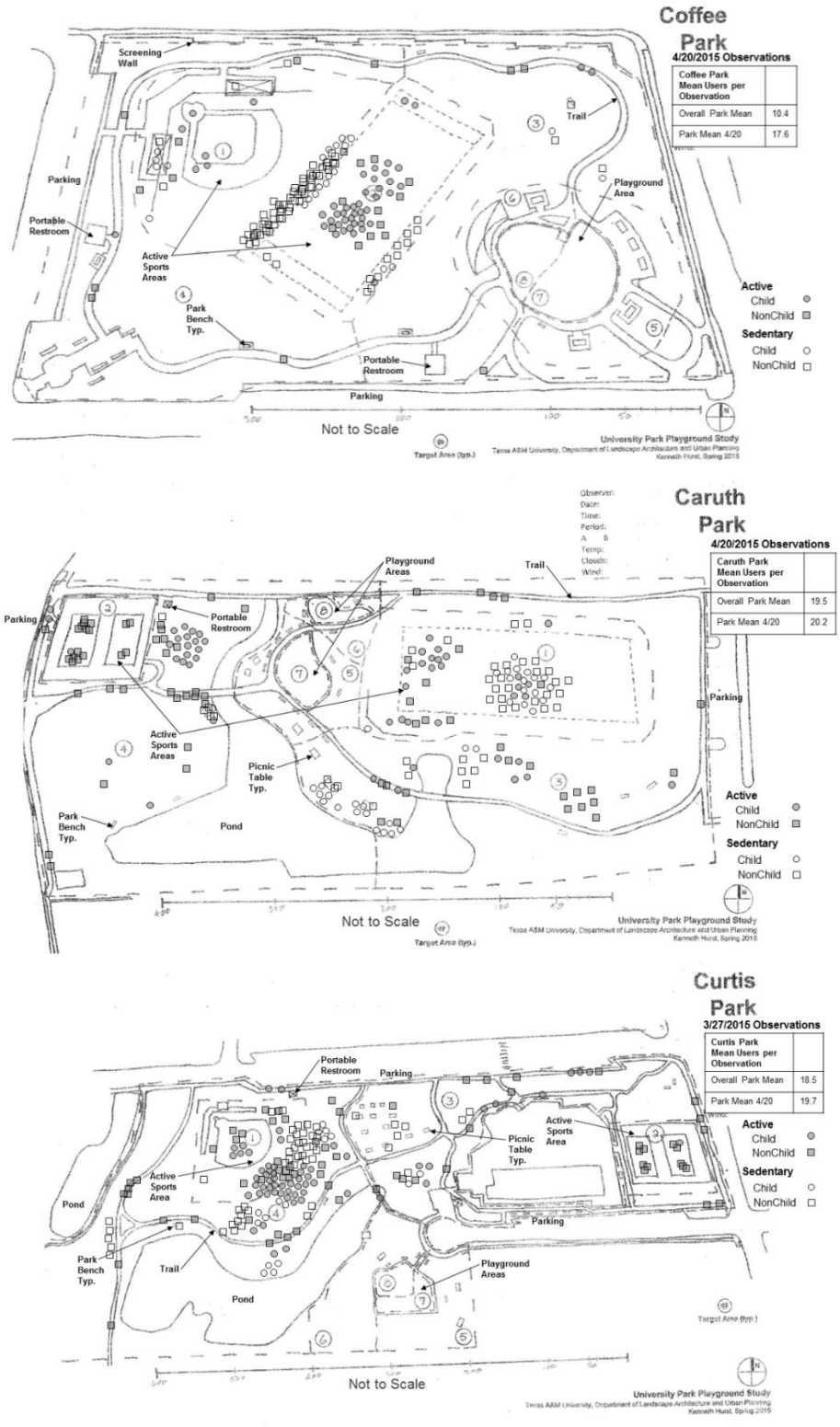


Figure 6.8: Behavior Map, Representative Single Day Park Users

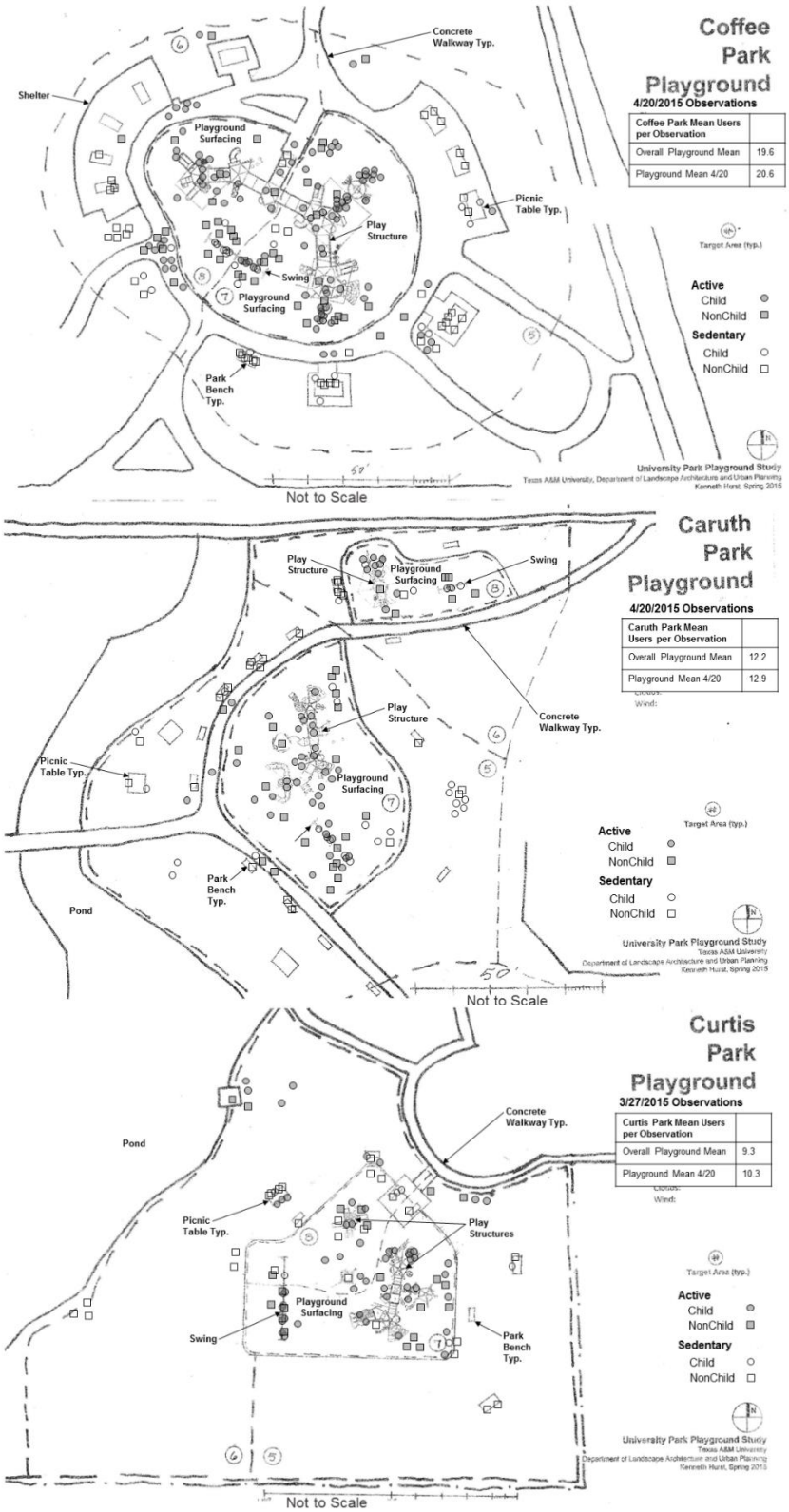


Figure 6.9: Behavior Map, Representative Single Day Playground Users

An interesting element of use in the Playground Zones is the observation of 7 adults on the play structure in Coffee Park and no adults on the play structures in the Comparison Parks. This pattern would suggest that parents and caregivers commonly use the ramps to access the elevated play structure themselves. The contribution of this improved access to the play structure by parents to overall use is in support of the hypothesis and could be the basis of further study of expressed preferences.

6.2.2 Physical Activity

Conduct exploratory research on the physical activity in park and playground areas, evaluating the effects that park and playground physical features, or affordances, including UD in the play environment, may have on physical activity in public parks. Figures on the recorded physical activity levels, Active versus Sedentary have been reported across the different behavior settings with their percent of the total for each age division. Effects of physical activity level are analyzed using descriptive statistics of the numbers of users by affordance setting and age group. Physical activity levels will be analyzed in terms of total and average metabolic equivalent (MET) scores of the recorded physical activity categories (VanDyck, et al., 2013, Cohen, et al., 2007). These will be evaluated in the Park Zone and Playground Zone with respect to their included affordances.

Physical Activity by Affordance Behavior Setting

Physical activity and its location in the overall public park environment is being reviewed and analyzed to make a contribution to evidence-based design in public open space by showing the benefits that UD offers to the general public. In addition to building a better knowledge base of where physical activity takes place in public parks, the demonstrated benefits

of increased park use, and increased physical activity is anticipated to give evidence supporting the use of UD in more playgrounds. An overview of physical activity levels in the parks is presented with users per observation by affordance setting showing the percent contribution each behavior setting area makes to the overall whole in Table 6.17.

Physical activity levels are consistent across all of the parks with a high of 65.8% of the users being physically active in Caruth and a low of 63.2% in Curtis. Coffee Park, at 63.6% is below the Combined mean of 64.3%. As a whole, percent of users being physically active in the Park Zones and Playground Zones are within 2 percentage points of the Combined mean. The one exception to this is that physical activity levels in the Park Zone in Coffee Park, which at 57.9%, is well below the mean. In contrast, the physical activity level in the Playground Zone of Coffee Park is the highest of the three and the highest of all the park zones at 66.6%.

In both the Park Zones and Playground Zones, the Site Furnishings show the lowest levels of physical activity with Combined totals of 10.1% and 9.2% respectively. Of these, the Site Furnishings area in the Playground Zone at Caruth Park is the lowest with only 2.2% physical activity. Physical activity levels in the Gathering Areas in both Zones are generally above 50% with the areas in the Playground Zone being 66.4% which is 12 percentage points higher than those in the Park Zone. Between these levels are the 44 users of the Shelter at Coffee Park who were observed to be 23.9% physically active.

Of the active areas in the Park Zones, the Active Sports Areas show 59.9% combined physical activity, likely as a result of high levels of spectators in the organized games. Also in the Park Zones are the Trails that have the highest levels of physical activity recorded in any of the behavior setting areas. Physical activity in the trails of all the parks registered at over 95% and with nearly 10% of the overall park users being on the trails, this is a significant contributor to the physical activity in the parks.

Table 6.17: Percent Active by Affordance in the Park and Playground Zones per Park

	COMBINED (n=210)		COFFEE (Case) (n=70)		CARUTH (Comparison) (n=70)		CURTIS (Comparison) (n=70)	
	User/Obs	%*	User/Obs	%*	User/Obs	%*	User/Obs	%*
ENTIRE PARK (TA 1-8)	29.81	64.3%	29.85	63.6%	31.56	65.8%	28.02	63.2%
PARK (TA 1-4)	16.12	62.9%	10.26	57.9%	19.42	66.1%	18.67	62.4%
Gathering Areas	4.30	54.4%	1.91	65.3%	4.67	67.6%	6.32	41.4%
Site Furnishings	0.66	10.1%	0.21	13.8%	0.77	11.1%	1.01	8.5%
Active Sports Areas	8.30	59.9%	7.20	52.0%	10.45	59.5%	7.26	68.4%
Trails	2.85	96.8%	0.94	97.7%	3.53	95.7%	4.09	97.6%
PLAYGROUND (TA 5-8)	13.69	65.9%	19.59	66.6%	12.14	65.5%	9.35	64.9%
Gathering Areas	2.38	66.4%	2.93	73.4%	2.41	56.2%	1.80	68.7%
Site Furnishings	2.41	9.2%	3.48	11.1%	1.95	2.2%	1.81	13.0%
Shelter	0.21	23.9%	0.63	23.9%	0.00	0.0%	0.00	0.0%
Play Structure	2.84	92.1%	4.84	89.2%	2.36	97.0%	1.31	94.0%
Swings	1.93	67.1%	2.36	66.4%	1.91	67.5%	1.51	67.8%
Play Surfacing	3.92	83.1%	5.36	83.6%	3.49	84.7%	2.91	80.4%

* Percent of users observed physically active

In the Playground Zones, there are three active use areas which are the Play Structure, Swings, and the Play Surfacing. Understandably, the Play Structure area has the highest level of physical activity, with a Combined total of 92.1% which would be higher if the physical activity level at Coffee Park weren't only 89.2%. While this could be considered a detriment to the cause for UD, on further examination, the Play Structure has over twice the number of users as at the other two parks so overall physical activity will be higher. The slightly lower percentage of physical activity could be the result of adult caregivers having been shown using the structure to be nearer their children but being in an inactive state.

The Play Surfacing areas exhibit similarly high levels of physical activity in all of the parks. Among the behavior settings, these areas have the third highest level of physical activity with a Combined total of 83.1%. In consideration of having the second highest use level among

the behavior settings, the Play Surfacing makes a higher than expected contribution to physical activity in the parks.

In terms of the percentage of physical activity in a behavior setting, the Swing areas are fourth among all of the settings. With a Combined total of 67.1%, the three parks exhibit very similar percentages, all being within 1 percentage point, either higher or lower than the Combined total. While Coffee Park does have the highest number of swing users, this use is not to the same degree as in the play structure, although the swingset, with only 4 swings has a 33% lower capacity as the swings at the other parks. Also contributing to the lower activity levels are children in the swing being recorded as sedentary because they were being pushed by caregivers. All this considered, the swings still ranked 4th in percent of users being physically active in the parks.

Among the park behavior settings, the Playground Zones have three of the four most active areas making the playground and its environment a significant contributor to physical activity among users in the park. The analysis will continue by reporting the total numbers of active users as a function of users per observation by behavior setting, removing the sedentary users from the total number. As a result, the reported users will all be physically active and the percentages shown are the percent of the given behavior setting with respect to the total active users for each park. These figures are reported for all users, child, and nonchild in Table 6.18, and for children alone in Table 6.19.

In the overall analysis of all park users, the split between the Park Zones and the Playground Zones is nearly equal for the combined users. Both the Combined totals of the Park and Playground Zones are within 3% of an even 50% split with the Park Zones being slightly higher. This follows the previous overall analysis of use as does the splits within the parks with Coffee Park having over two-thirds of the physical activity in the Playground Zones and Caruth

and Curtis Parks having nearly two-thirds of the physical activity in the Park Zones. When physical activity among children is analyzed, the magnitude of the spread is weighted more heavily toward the Playground Zone in Coffee Park, yet while the difference between the zones in Caruth and Curtis Parks still favors the Park Zones, the spread is reduced with the Playground Zones having over 40% of the child physical activity.

Within the behavior settings themselves, physical activity in the Play Surfacing area has the second highest number of users in consideration of all users, but falls behind the Play Structure area when only numbers of physically active children are reported. Overall, the patterns maintain a similarity to the previously reported patterns and ratios. These figures are reported in preparation for the analysis of physical activity in terms of energy expended or METs.

Table 6.18: Active Users by Percent in Affordance Areas per Park

	COMBINED (n=210)		COFFEE (Case) (n=70)		CARUTH (Comparison) (n=70)		CURTIS (Comparison) (n=70)	
	User/Obs	%*	User/Obs	%*	User/Obs	%*	User/Obs	%*
ENTIRE PARK (TA 1-8)	19.16		18.99		20.78		17.72	
PARK (TA 1-4)	10.14	52.9%	5.94	31.3%	12.84	61.8%	11.65	65.7%
Gathering Areas	2.34	12.2%	1.25	6.6%	3.16	15.2%	2.61	14.8%
Site Furnishings	0.07	0.3%	0.03	0.2%	0.09	0.4%	0.09	0.5%
Active Sports Areas	4.97	26.0%	3.74	19.7%	6.21	29.9%	4.96	28.0%
Trails	2.76	14.4%	0.91	4.8%	3.38	16.3%	3.99	22.5%
PLAYGROUND (TA 5-8)	9.02	47.1%	13.05	68.7%	7.94	38.2%	6.07	34.3%
Gathering Areas	1.58	8.3%	2.15	11.3%	1.36	6.5%	1.24	7.0%
Site Furnishings	0.22	1.2%	0.39	2.0%	0.04	0.2%	0.24	1.3%
Shelter	0.05	0.3%	0.15	0.8%	0.00	0.0%	0.00	0.0%
Play Structure	2.61	13.6%	4.31	22.7%	2.29	11.0%	1.24	7.0%
Swings	1.29	6.7%	1.56	8.2%	1.29	6.2%	1.02	5.8%
Play Surfacing	3.26	17.0%	4.49	23.6%	2.96	14.2%	2.34	13.2%

* Users observed being physically active as a percent of Total Active Park Users

Table 6.19: Child Active Users by Percent in Affordance Areas per Park

	COMBINED (n=210)		COFFEE (Case) (n=70)		CARUTH (Comparison) (n=70)		CURTIS (Comparison) (n=70)	
	User/Obs	%*	User/Obs	%*	User/Obs	%*	User/Obs	%*
ENTIRE PARK (TA 1-8)	10.88		12.49		11.02		9.12	
PARK (TA 1-4)	4.87	44.7%	3.66	29.3%	5.71	51.8%	5.23	57.3%
Gathering Areas	1.30	11.9%	0.63	5.0%	1.67	15.2%	1.59	17.5%
Site Furnishings	0.03	0.2%	0.01	0.1%	0.01	0.1%	0.05	0.5%
Active Sports Areas	2.91	26.7%	2.85	22.8%	3.41	30.9%	2.46	27.0%
Trails	0.64	5.8%	0.16	1.3%	0.62	5.6%	1.12	12.3%
PLAYGROUND (TA 5-8)	6.01	55.3%	8.84	70.7%	5.31	48.2%	3.89	42.7%
Gathering Areas	0.97	8.9%	1.41	11.3%	0.79	7.2%	0.70	7.7%
Site Furnishings	0.06	0.5%	0.08	0.6%	0.03	0.3%	0.07	0.8%
Shelter	0.03	0.3%	0.09	0.7%	0.00	0.0%	0.00	0.0%
Play Structure	2.36	21.7%	3.81	30.5%	2.07	18.8%	1.19	13.0%
Swings	0.64	5.9%	0.77	6.2%	0.68	6.2%	0.46	5.1%
Play Surfacing	1.96	18.0%	2.66	21.3%	1.74	15.7%	1.47	16.1%

* Children observed being physically active as a percent of Total Active Children

Physical Activity METs by Affordance Behavior Setting

Metabolic equivalents or METs have been an established methodology in the analysis of physical activity in a variety of research settings. These units represent a comparative scale that can give an indication of energy expended by park users and against which different physical activities can be measured versus sedentary behaviors (Ainsworth, et al., 2011). The MET units have been widely applied in physical activity research and are used in the SOPARC evaluations giving sedentary physical activity 1 MET, walking 3 METs, and vigorous 6 METs (Van Dyck, et al., 2013). Data collection combined walking and vigorous physical activity, as a result, the active physical activity level will be the average between walking and vigorous resulting in 4.5 METs for active, with 1 Met being used for sedentary. These figures are reported in terms of METs per observation for all users, child and nonchild in Table 6.20, and for children alone in Table 6.21.

Beginning with the Total Park figures, the MET numbers line up pretty well with the general use numbers. The three parks are similar overall within 8% of the Combined total. Coffee Park is nearly equal to the combined total with 96.3 METs per observation. Caruth Park is the highest and Curtis Park is the lowest. The Combined Park Zones generate just over one half the METs at 51.6 and the Comparison Parks being nearly double that of the Case. In the Park Zones, the Active Sports areas generate the highest MET scores of any single area with a combined total of 25.71 and Caruth Park has the highest score in its Active Sports Area of 32.2. The MET score for Coffee Park has approximately 65% in Active Sports following the general pattern of use in the parks. Trails in both Caruth Park and Curtis Park generate nearly half the Active Sports METs with over 15 METs each, evidencing the substantial contribution trails make to overall physical activity in parks.

Table 6.20: METs per Observation in Affordance Areas per Park

	COMBINED (n=210) METs	COFFEE (Case) (n=70) METs	CARUTH (Comparison) (n=70) METs	CURTIS (Comparison) (n=70) METs
TOTAL PARK (TA 1-8)	96.88	96.30	104.29	90.04
Park Zone (TA 1-4)	51.61	31.03	64.34	59.44
Gathering Areas	12.50	6.29	15.71	15.47
Site Furnishings	0.90	0.31	1.07	1.31
Active Sports Areas	25.71	20.30	32.20	24.63
Trails	12.51	4.14	15.36	18.04
Playground Zone (TA 5-8)	45.27	65.27	39.94	30.60
Gathering Areas	7.91	10.46	7.17	6.13
Site Furnishings	3.19	4.83	2.10	2.64
Shelter	0.39	1.16	0.00	0.00
Play Structure	11.99	19.94	10.39	5.64
Swings	6.45	7.83	6.44	5.09
Play Surfacing	15.34	21.07	13.84	11.11

In the Playground Zones, Coffee Park has nearly 40% more physical activity than does Caruth Park and over double that of Curtis Park. With a total for the Playground Zone of 65.27, the Coffee Park Playground Zone generates more physical activity as measured in METs than any of the other entire park zones of all the parks. In terms of the active play areas composed of the Play Structure, Swings, and Play Surfacing, the active playground area combines for nearly 49 METs per observation, also the highest of the active areas among the three parks. These figures would tend to add to the support for the hypothesis of the value UD adds to attractiveness and value in play environments.

Table 6.21: Child METs per Observation in Affordance Areas per Park

	COMBINED (n=210) METs	COFFEE (Case) (n=70) METs	CARUTH (Comparison) (n=70) METs	CURTIS (Comparison) (n=70) METs
TOTAL PARK (TA 1-8)	52.03	59.94	52.59	43.56
Park Zone (TA 1-4)	23.17	17.41	27.26	24.86
Gathering Areas	6.25	2.94	7.94	7.86
Site Furnishings	0.19	0.10	0.19	0.27
Active Sports Areas	13.83	13.63	16.24	11.61
Trails	2.91	0.74	2.89	5.10
Playground Zone (TA 5-8)	28.86	42.54	25.33	18.71
Gathering Areas	4.62	6.61	3.87	3.37
Site Furnishings	0.72	1.09	0.47	0.61
Shelter	0.18	0.53	0.00	0.00
Play Structure	10.74	17.53	9.36	5.36
Swings	3.44	4.21	3.61	2.50
Play Surfacing	9.16	12.57	8.01	6.89

When measuring Child METs, there is a considerable difference between the proportions of overall physical activity generated by children in the Park Zones in comparison with the

Playground Zones. Of the total physical activity in the Park Zones, METs generated by children is just under half of the total measured METs. In the Playground Zones, child physical activity measured in METs is nearly 70% of the overall measured physical activity. Similar patterns are evident in the amounts of activity in each park per Zone across all of the parks except that the impact of METs in the Coffee Park Playground Zones are magnified as the reduction from all users to child users is less than in the other zones. Consistent with this is the total METs in the active playground areas is over 34 which is considerably higher than any of the Park Zones. This adds another dimension to support the hypothesis of the contribution UD makes to the playground environment.

7. SUMMARY, DISCUSSION, AND CONCLUSION

This cross-section case study examined if the playground designed to exceed the 2010 ADA Standards for Accessible Design (Universal Design or UD) generate more users, compared to those designed to simply meet ADA standards (Accessible Design or AD). It further examined specific physical elements or affordances with respect to overall use and levels of physical activity generated.

This research contributes to the larger body of knowledge in evidence-based approaches to the design of public outdoor environments and to the literature linking environmental designs with public health outcomes such as physical activity and play. This research is intended to impact future policy and physical interventions to promote active living and public health through the increased use of outdoor spaces for physical activity.

7.1 Summary

7.1.1 Primary Aim

Across the three study parks, including all the Park Zones and the Playground Zones (TA 1-8), descriptive analysis of the number of users in each park showed similar overall use levels (Table 6.1). This, along with the fact that they are proximately located within the same city, helps ensure that the three parks are comparable in characteristics other than the main study variable of the playground design (UD vs. AD). The playground area was the most popularly used space in all three parks, accounting for nearly half of the overall use in the entire park inclusive of scheduled active sporting events such as children's soccer games.

While the playground areas are the subject of this study, observations of park users in the entire park were recorded to account for the potential confounding effects of the activities outside of the playground environments. This study found that the two Comparison parks had nearly twice the use levels in the park areas outside the play environment (Park Zones, TA 1-4) than in the Case park (Table 6.1). This finding helps relieve the concern that the higher playground use level in the case park may be attributable to having more people elsewhere in the park.

Descriptive statistics showed the mean user level at the Coffee Park playground to be over 60% greater than that in the Comparison playgrounds. These use levels are the inverse of the relationship in the Park Zones (Table 6.1). Bivariate statistical test using ANOVA confirmed that the mean user counts in the Playground Zone differ significantly across the three parks (Table 6.9).

Further analyses testing the potential influence of various observation related variables such as observation day, time, weather condition, etc., showed no significant divergence from overall support for the hypothesis. However, some variations are found as a result of these tests. Weekend use in the Park and Playground Zones was higher in all cases except in the Park Zone of Curtis Park where weekday use was higher, likely due to soccer games and other organized sports (Table 6.1). Use in the Playground Zone between the parks shows a similar pattern of the highest use at Coffee Park although weekend use at Caruth Park is considerably higher than weekday use. Among the five time periods, the lowest level of use was recorded in the Dawn time period in all the Zones across the three parks. The Park Zones had the heaviest use in the Afternoon and Evening periods where the Playground Zones had the most use in the Morning, Noon and Afternoon periods (Table 6.1). In terms of the weather condition, slightly higher levels of use was recorded on clear days than on days having an overcast, and use was also higher on

days where the temperature was over 70°F. Weather related variables did not have significant confounding effects on use relationships relative to the hypothesis. This analysis supports the assumption that the variables of observation day, time, and weather condition can be considered controlled.

The final bivariate analysis was performed breaking out mean observed users per play event and mean observed users per square foot. In both of these analyses, the relationship of use in the Coffee Park Playground Zones is considerably greater than the use in the Comparison Playground Zones (Table 6.15) giving further support to the hypothesis that UD makes a positive and significant ($p<0.01$) contribution to overall playground use.

Multivariate regression analysis was conducted to further test the significance of UD in predicting the observed user count in the play environment, after controlling observation-related control variables including observation day (weekend/weekday), observation time, and weather (cloud cover and temperature). The dependent variable was a count variable with a large number of zero values and over-dispersed distribution (Figure 6.1) making Zero-Inflated Negative Binomial regression the most appropriate model (Figure 6.4, Table 6.16). The UD variable exhibited the strongest and most significant ($p<0.001$) association with the user count. UD, compared to AD, led to 84.1% positive change in the play environment user count. This provided strong evidence supporting the hypothesis that UD increases playground use. The next strongest is the observation day variable, with the weekend observations being associated with 40.3% more user counts ($p<0.01$). The remaining variables of observation time period, temperature, and cloud cover influenced the user count with a relatively smaller percentage level change in the teens.

In addition to the four control variables of observation day, time period, cloud cover, and temperature, there are ten potential confounding variables representing physical elements in and

of the park environment (Table 6.12). These variables have the potential to threaten the validity of the assumption of similarity of the three parks where the substantial physical variables are considered largely controlled. These variables are grouped by influence in the Park Zone and influence in the Playground Zones. Of the significant variables, Trail Length, Tree Canopy, Water, Parking Spaces, Playground Surface, Play Events, and Benches have less than 10% of the influence had by UD, and Picnic Tables have about 25% (Table 6.13 and Table 6.14).

The multivariate analysis looks at the percentage of influence the independent variable UD has on the dependent variable of observed use regressed with the control variables and the confounding variables. Among the four control variables and the ten confounding variables, all but two of the confounding variables showed statistical significance. In all of the cases, the magnitude of influence on the outcome shown by the independent variable UD was much greater than the influence shown by any of these other variables. The significance of the zero-inflated negative binomial regression and the magnitude of the difference in the effects support the assumption that the physical variables are controlled and lend more rigorous support to the hypothesis that UD has a positive influence on playground use.

7.1.2 Secondary Aims

The secondary aims take a less structured look at use throughout the entire park environment in the three parks relative to the affordances which are physical elements that support various activities or behaviors in the park. They look beyond UD to make an exploratory evaluation of relationships between other park and playground elements, their use and their contribution to physical activity. In the original recording and quantitative analysis, the Park Zones and Playground Zones were each made up of four target areas, two primarily active, and two primarily passive in intended use. For the qualitative analysis, the Zones were re-

organized into behavior settings largely based on the physical elements or affordances that supported activity types.

Use of Affordances

In the Park Zones, the behavior settings that received the greatest use were the Active Sports Areas, followed by the Gathering Areas which often had spectators overflowing from the programmed events in the Active Sports Areas. The Trails received regular use, especially in the early times when there was little other park use (Table 6.21).

The active behavior settings of the Playground Zones of Play Structure, Swings, and Play Surfacing receive nearly as much overall use as the active areas in the Park Zones. It is interesting to note that, the Play Surfacing recorded the most use among the playground areas in all of the parks. In Coffee Park, the Case, these playground areas are the most highly used of all the park areas. The Playground Gathering Areas in all of the parks received high use levels and the Site Furnishings in the Playground Zones received on average more use in contrast to those in the Park Zones where the Site Furnishings were very lightly used (Figure 6.7).

In an overall ranking, the Active Sports Areas, and Gathering Areas settings of the Park Zones had the most use followed closely by the Play Surfacing in the Playground Zones and the Trail setting. There were minor variations across the three parks but the Active Sports Areas setting received the highest use in all three parks. The Play Surfacing setting ranked higher in Coffee Park, compared to the other two parks. The Site Furnishings settings ranked low in each park, but should still be given ample consideration in design as resting areas for park users (Figure 6.7).

When comparing the ratio between Child and NonChild users, Park Zones were dominated by NonChild users with Child/NonChild Ratios (CNR) of less than 1.00. In the

Playground Zones, overall CNR ratios were over 1.00 with the exception of the Site Furnishings. The active play areas of Swings, Play Surfacing, and Play Structure were over 1.00 in all of the parks. The Play Structure area had the highest proportion of child users as expected (overall average of CNR ratio of 7.22), but this area in Coffee Park had the lowest CNR at 6.28 compared to the other two parks which had CNRs of 7.95 and 11.27 (Table 6.16).

Behavior mapping was done for a representative day in each park to gain a more detailed understanding of the park/playground users and their activities. In the Park Zones, the behavior maps showed many primarily sedentary people watching children's active sports games and spilling into the adjacent park gathering areas. Trail users were mostly active NonChild whose symbol reflects the location where the participants were observed. Picnic tables and park benches received some use in the Park Zones but were not highly utilized based on the mapped data (Figure 6.8). In the Playground Zones, both active and sedentary users were mapped throughout the play area with clusterings of users around swings, on spiral slides and ground level climbers. The use of site furnishings was much higher in the Playground Zones than in the Park Zones. On the play structure itself, adult users (NonChild) were found in Coffee Park but not in either of the Comparisons (Figure 6.9). This may be a result of the ramp access giving an easy path for parents who want to be near their children.

Physical Activity

In the case of overall combined percentage of users being physically active, the Trails settings registered the highest percentage of active users while exhibiting just over the median level of use (Table 6.17). In terms of physical activity expenditure, the Trails ranked third in metabolic equivalents (METs) behind only the Active Sports Areas and the Play Surfacing areas (Table 6.20). The second highest areas in terms of percent active were the playground Play

Structure followed closely by the playground Play Surfacing (Table 6.17). Among all areas from all three parks studied, the play area in Coffee Park was the strongest contributor to physical activity, given its overall high use level and the high percentage of active users.

In terms of total MET scores, overall physical activity and MET production across the three parks is highest in the Active Sports Areas in the Park Zones, yet the active areas of the Playground Zones combine to come close making a substantial contribution. The Playground Zones generate nearly half of the total MET energy across the three parks. The Playground Zone in Coffee Park, the Case generates the highest number of total METs that are generated in all the parks. The combination of the three active playground areas in Coffee Park, the Case, results in over 48 METs per observation which is by far the greatest generator of physical activity for users of all ages across all of the parks, giving unanticipated support to the original hypothesis as presented in the Primary Aim (Table 6.20).

Extending the MET data from overall users to child users serves to strengthen the finding. The play structure alone in Coffee Park shows a higher level of child METs than any of the areas in the parks of any description. With a combination of the play structure, playground surfacing, and swing areas, the playground at Coffee Park alone contributes over 34 METs, which is more child METs than any of the remaining Park or Playground Zones among the three parks contributing more support for the original hypothesis (Table 6.21).

7.2 Discussion

The three relevant domains within which this study can make a contribution are theory, research, and application. Each has a role in the overall body of knowledge where theory and research are primarily in the realm of academia, and implementation takes on a multiplicity of dimensions in practice.

7.2.1 Theory

The literature has recognized the need for developing environmentally specific inquiry through the social ecological model that looks at physical characteristics of place which encourage participation and physical activity contributing to Active Living. This body of theory reflected in the social ecological model guides selection and evaluation of various elements of the physical environment and the ways they influence different behaviors (Sallis, et al., 2006). Within the framework of the social ecological model and behavior setting theory, this research has focused on playground and park use and specific qualities of settings in the park and playground environment that support use and physical activity. Findings of the primary aim and hypothesis based on the broad theory of this model supported the hypothesis of UD, a specific construct of the play environment behavior setting, as having a positive effect of drawing park users to a given place and participating in physical activity.

As a part of the secondary aims, data has been gathered in behavior settings characterized by specific physical elements theoretically expressed as affordances that are components of the overall park environment. These settings were evaluated using an open-ended approach without the preconception of a hypothesis. Along with support for the hypothesis, playground participation across the three subject parks recorded 46% of the total use in the three parks. This serves to illustrate the important contribution specific behavior settings of play areas and overall play environments make in the social-ecological construct of public parks.

Within the playgrounds, on an intrapersonal basis, it was interesting to note that adult participation was greater than expected, being over 43% of the users across all of the parks in the study. Among these adult users approximately 75% were female. In the Coffee Park playground behavior plot maps, adults were observed on and using the ramp accessible play

structure where only children were actually recorded on the elevated structure in the other playgrounds. This single day observation is supported by the lower Child/NonChild ratios on the Coffee Park play structure in comparison with the other playgrounds. This gives further indication of the universal value UD contributes to the play environment.

7.2.2 Research

Methodologies used in this research were intended to apply established protocols to observational research in ways that help answer new research inquiries. The SOPARC protocols provided the methodological foundation of this research (McKenzie, et al., 2006). Application of these protocols to a graphic format and translation of the data relating to behavior settings and affordances build on some recent leading research using graphic methods (Cosco, et al., 2010; Moore & Cosco, 2007). Use of unique graphic symbols to record 12 levels of the SOPARC directed data gives a new dimension to the observational research and offers the opportunity to make qualitative evaluations of user location and activity.

The graphic recording format allows the data to be used both quantitatively and qualitatively. The quantitative entry produced output that is statistically analyzed to test the research hypothesis. For the qualitative analysis, the Park Zones and Playground Zones were re-organized from target areas as outlined in SOPARC into behavior settings largely based on the physical elements or affordances that support activity types similar to Moore & Cosco's work (Moore & Cosco, 2007).

This approach allows a unique analysis perspective where individual elements in the park and play environment are evaluated within different behavior settings. The existing research evaluates use in play areas as an overall analysis setting with renovated versus un-renovated play areas (Colabianch, et al., 2011; Ridgers, et al., 2010b; Mowen 2010; Kerr, 2007).

Evaluation in these studies is in terms of the overall play environment rather than in terms of specific elements. Comparison of different specific elements or conditions such as UD in comparative settings as in the Case playground of this research was not evident.

Two studies did locate child users graphically which this research has sought to build upon. In these studies, data on child use was presented and analyzed with respect to different behavior settings then behavior maps were made showing where children were observed (Cosco, et al., 2010; Moore & Cosco, 2007). This study seeks to build on existing research by comparing separate playground environments built to different standards.

The graphic recording of users and activities on the map of the Park Zones and Playground Zones for each park provided additional qualitative information as to where users and activities cluster and if there are any spillover effects from adjacent areas. For example, in the Park Zones, most of the use was in the active sports areas such as sports fields and tennis courts. In the sports fields, much of the use spilled over into the adjoining gathering areas. Trails were widely used overall, but benches and picnic tables were popularly used only in the Playground Zones. Plots of use in the Playground Zones showed use concentration around swings and slides, specifically spiral slides, and also around ground level climbing elements.

These specific user clusters begin to demonstrate value and contribution of specific elements to the use of the playground environments and help fill in the gaps in existing literature. The ability to visualize use can contribute to the richness of the research by adding a visual component communicating the numerical outcomes. The graphic location is also more specific on a plan than could be communicated numerically. It communicates by showing clusters of users where people tend to gather more often and what they are using. Future research application of GIS methods has the potential to further strengthen the interpretability of the results by being able to include data from the entire study and graphically displaying use in terms

of intensity by color coding regions of a map as having higher use levels. It could also easily sort use data by physical area for statistical analysis.

7.2.3 Application

Application of this research to practice has the potential of impacting design practice through the implementation of supportive public policy. Facilities conceived and implemented through these practices and policies can make a positive contribution to the overall health and welfare of the general public impacting people with different levels of abilities and resources.

Public Health

Health benefits of outdoor activities range from stress relief by being exposed to nature and escaping from daily pressures to the actual healing benefits of play and physical activity (Logan & Selhub, 2012; Gariepy, 2003; Moore, 1999; McCreary, et al., 2012). Complementing this research is research showing a positive correlation between the built environment and physical activity in adults and children (Sallis, et al., 2000). The benefits of play, being outdoors, and physical activity are not directly measured in this research, but identifying specific environmental correlates of use in parks and playgrounds is central to the research. The hypothesis itself relates to the higher use as an outcome of incorporating UD into public playgrounds.

In healthcare facilities, therapeutic gardens have seen significant support in the literature with respect to their value in reducing stress and improving satisfaction among patients, staff and visitors (Ulrich, 1999; Sherman, 2005). The literature has also shown that therapeutic gardens while having demonstrated value, have gone under-utilized (Sherman, 2005). Use of play facilities in the public outdoor spaces of healthcare facilities creating a more active use version

of therapeutic gardens is growing in practice. In those facilities, many of the people who use the outdoor environments for respite have a variety of disabilities. The findings of this research can contribute to the support of design practice in showing the value of UD in active play environments attracting more users to the therapeutic garden environment addressing the issue of underutilization.

The data and ensuing statistical analysis have given support to the increased use levels being attributable to UD in the play environment. These increased use levels are complemented by analysis of MET scores which generated 65.27 METs per observation in the Case play environment using UD. These MET scores are at the highest levels of any of the Park or Playground Zones including the active sports areas. The Comparison Playgrounds also produced high MET scores, with just under half the measured METs generated in the Playground Zones across the three parks (Table 6.20). The high MET score in the Case Playground Zone is largely a function of increased use as the difference in both the percent active and METs/user scores between the Case and Comparisons is insignificant. This similarity of physical activity levels and METs/user in the Playground Zones is not considered to be a threat to support of the hypothesis as the hypothesis was stated in terms of overall activity which does find support as a result of the high MET score of the Playground Zone in Coffee Park.

In addition to UD, the research also identifies specific elements in the playground environment that make a contribution to use. These include swings and spiral slides on the playground itself, and park furnishings surrounding the playground. This shows that playgrounds in parks contribute to both increased user presence leading to increases in physical activity levels for all park users whether they be child or adult. These findings relative to physical elements drawing users to the park complement studies on play which discussed how exposure to nature results in getting children outdoors and their being more active with the

accompanying benefits to cognition and health (McCreary, 2012; Mowen, 2010; Louv, 2008; Moore & Cooper Marcus, 2008; Kerr, 2007).

Design Practice

The original conceptualization of this research is the result of the author's personal experiences with the design and construction of over 700 play environments in over 25 years of practice. During this time period, adherence to ADA was always an important consideration and play environments that were built to the highest levels of accessibility, surpassing the minimums of ADAAG, were anecdotally seen to be more popular. With the continued development of ADAAG, the idea of UD, going beyond the minimum standards, was conceptualized and began to grow in acceptance. Along with the observed popularity, UD was seen to bring, was the experience of resistance from funding sources to accommodate the additional resources involved in the more costly surfacing and structural elements of the play environment thought to accommodate only a "small minority of users". Some also thought that accessibility was accompanied by a lower challenge in play and therefore less fun. This research has sought to address these issues by showing support for the increased use of UD in the play environment by people of all abilities.

The value of inclusive play environments for children with disabilities has been well documented. The emotional and social dimensions of play environments for children with disabilities is central to the research as is the need for them to be accepted by the general population of children without special needs (Burke, 2012; Jenanes, 2012; Prellwitz & Skar, 2007). Accompanying this is the limited guidance on the specific parameters for building special needs play environments (Goltsman, 2011; Moore & Cosco, 2007). The element that is missing from these discussions is how are the able bodied children, with whom those having

special needs are striving to connect, attracted to special needs play environments? This research has attempted to fill this gap by documenting in comparative play environments how much more a playground built to UD standards is used by everyone than those built only to AD standards. The significantly higher use and physical activity values of UD found in this study can help support the application of UD in future play environments.

Beyond the hypothesis and UD, the research took a qualitative look at use in the playground by dividing it into different behavior settings. Among these settings, there was more recorded use on the Play Surfacing than with any of the other single setting including the Play Structure itself. Among the individual settings, swings were a focus of concentrated activity in all of the playgrounds. Other nodes of activity on the play structure included spiral slides and ground level climbing apparatus. From a more passive perspective, park benches and picnic tables were much more heavily used in the playground settings than in the overall park settings. An unanticipated finding is that playground use makes a substantial contribution to park use overall.

Users categorized as NonChild were nearly all adult and were found to be over 43% of the users in the Playground Zones. Knowledge of the contribution adult caregivers provide to children's play, if only the mere matter of getting children to the playground, should have important design implications in the practice of designing, building, and maintaining play environments as a whole.

The literature has identified gaps relative to research in specific physical elements of the outdoor environment relative to use and physical activity (Kaczynski & Henderson, 2008; Colabianchi, et al., 2011). There are also few studies in park and playground research using graphic methods such as behavior mapping doing comparative evaluation of the contribution of different elements and behavior settings within outdoor environments. This research has sought

to fill this gap by combining the disciplined protocols of the SOPARC observation system with behavior mapping making a contribution to knowledge in evidence-based design with respect to the contribution specific behavior settings, constructs of those behavior settings, and physical elements of the settings make to use and physical activity (Cosco, et al., 2010; Moore & Cosco, 2007, McKenzie, et al., 2006).

Policy

This research and some of the accompanying documentation on specific physical park elements should help give support to playground advocates when approaching policymakers for funding of the more expensive UD facilities. These playground advocates may be both members of the general public striving to have playground facilities built or they may be internal park professionals competing with other municipal interests for funding. Either way, this research is anticipated to give support to the greater implementation of UD facilities by demonstrating their overall value to the public as a whole.

The observation instrument can become a tool for both facility assessment in the evaluation of strategies for park and playground renovations and improvements. They can be used as a comparative tool for proposed projects and in post-construction evaluation of the effectiveness of a finished project. The tool has the capability of recording use on multiple levels that can focus on pertinent issues such as contribution to physical activity and use by people of a variety of demographics.

Findings in this study are in support of city policies advocating play environments in parks and schools toward the goal of getting children and their families outdoors and more active. There is further support of UD in the play environments increasing physical activity through more use by people of all abilities in favor of building these facilities for people having

different disabilities. This evidenced-based support of parks, playgrounds, UD, and the other identified elements should make a contribution to policies benefiting the overall health and welfare of the residents.

7.3 Limitations

Many of the limitations of this research are a result of the unique setting of the three parks in the city of University Park. The setting was chosen by virtue of the many moderator variables that are held at similar levels allowing them to be considered controlled. This is a critical assumption which if not supported by the analysis of physical elements could create a significant threat to the study's internal validity. One of the greatest limitations of the research is that it is being conducted within a single city and state, within three discreet parks, and using a single specific class of playground equipment. As a result, generalizability or external validity is limited to settings and characteristics similar to this study.

Some regional aspects of the study setting are also of a singular nature. Demographics were conducted in a racially and demographically homogeneous setting, therefore no racial data was collected on the participants. The setting was in a city that is largely a bedroom community having a substantially higher income profile, in one geographic region, the southwest. Incorporation of communities in other regions and those having other use and income profiles would add strength to the generalizability of the finding. Statistically, the three park environment limits statistical strength because no matter how many observations are made and users recorded, there are still only three parks being compared (n=3). More parks and their playgrounds would improve statistical significance and support more rigorous statistical analysis methodologies. Further, the bivariate and multivariate statistical analyses did not account for the

data clustering at the park level, which have been shown to increase the risk of committing the Type I error (false positive - finding a false relationship).

The age of the participants was estimated based on participants' appearance of being within age grouping parameters, rather on a stated age. Because IRB protocol did not allow contact with participants for this passive observational study, precise knowledge of a participant's age, either child or otherwise, was unknown. The study is conducted only in the spring of the year during a distinct time period while school is in session. Patterns may change when school is not in session, and at other times of year with seasonal differences further impacting generalizability.

In accordance with IRB approvals, this study only uses observations of people's revealed preference in what they are doing. There were no surveys done seeking to identify perceptions or the expressed preferences of why they are engaging in a given behavior pattern. Perceptual preferences were left unknown and the findings are a result of observed behaviors alone.

7.4 Future Work

More observations could be done in park environments around the State, Country, or World to see if the pattern exists on a broader scale to strengthen generalizability. Observations in different parks could also include different racial and socioeconomic demographics evaluating effects those variables may have. These additional observations could also be extended into different times of the year with generally different weather patterns. Expansion of the observations into different parks in different cities and regions will also have the effect of expanding available statistical methods where multilevel modeling will become possible where it was previously limited by the low number of settings.

More focus could be given to future research on the effects park elements have on physical activity evaluating different levels of physical activity related to a specific amenity. Longitudinal studies could also be done with a pre-test, intervention, post-test research design using observation data in the pre-test and post-test conditions. This methodology has the potential to return stronger generalizability toward the effect specific amenities have on use and physical activity in a variety of venues.

The combination of observation data with survey data could reveal how far people travel to a facility potentially identifying differences in the service area, how often they use the area, size of family groups, and more. They could also reveal a variety of perceptual variables including feelings about certain park elements and qualities that could be pertinent to park use. Including surveys complimentary of observations can fill a literature gap coupling observation data with survey data. Variables involving comfort and safety could be evaluated with these methods. Survey data could also gather more information concerning physical activity habits and the specific effects park amenities have on physical activity.

This research gathered spatial data and did some rough evaluation using manual graphic methods of single representative days. Application of new computer driven GIS tools could allow compiling of the spatial data for the combined observations that could potentially derive additional spatially based conclusions and allow easier evaluation of the data using automated means. Research and development of different GIS models and their application could impact behavioral analysis in a broad range of settings and purposes. This type of refinement of the methodologies could impact behavioral research in public outdoor settings from parks as applied herein, to urban spaces, schools, hospitals, child-care and senior centers, and much more. While these methodologies are applied to research in playgrounds, they are not specific to play

environments and could be used to fill gaps in evidence-based design in many environments focusing on many different physical elements.

7.5 Conclusion

This research has sought to address many of the knowledge gaps through the Primary Aim and Hypothesis by making a focused examination of the effect the specific amenity UD has on use in the play environment, using established observation protocols. It looks at the contribution inclusive play (UD) as a specific construct and amenity class, makes to the general public as a whole, having the potential to encourage more use by people of all abilities, with the accompanying health benefits for adults and children alike (Burke, 2012; Jeanes & Magee, 2012; Goltsman, 2011; Prellwitz & Skar, 2007; Moore & Cosco, 2007). Through the Secondary Aims, it takes a more comprehensive look at some of the specific park and playground elements and their contributions to the promotion of getting people outdoors and physically active (Colabianchi, et al., 2011; Kaczynski, et al., 2008).

In addition to the stated aims and hypothesis, this research has sought to build on existing observation methodologies by adding a graphic dimension to observational research in outdoor recreation settings. The methodologies have striven to expand the horizon of observational research by combining a strong graphic component with accepted protocols using target areas and checklists, then applying analysis with accepted statistical methodologies. It is one of the few if not the only study to take a quantitative approach to the comparative evaluation of specific correlates of park use employing graphic recording methods, then analyzing the data with both quantitative methods and qualitative graphic output.

The park behavior settings were dominated by use in the active sports areas with organized children's sports such as soccer. Spectator use overflowed from children's events into

the more passive gathering areas. Park benches and picnic tables were found to be lightly used in the park settings. Park trails were well used by trail walkers and joggers, 3.8% of whom had canine accompaniment. Weekend use was found to be higher across most of the park settings and analysis of the time periods showed playground use to be generally greatest in the three mid-day time periods where park use was greatest during the two latter time periods as a result of scheduled children's athletics. Very low use levels were recorded in the first early time period which was dominated by trail users.

Of the playground behavior settings, there was more recorded use on the playground surfacing than with any of the other single settings, followed by the play structure and swings. From a more passive perspective, park benches and picnic tables were well used in the playground environment, much more heavily so than in the park settings. Playground participation recorded a mean of 46% of the total use across the three subject parks illustrating the important contribution playgrounds and the overall play environments make in public parks. Within the playgrounds, adult participation contributed over 43% of the users across all of the playgrounds in the study, of which approximately 75% were female. The contribution adult caregivers make to children's play is substantial, if only the mere matter of getting children to the playground, having the potential to make a positive contribution to the practice of designing, building, and maintaining play environments as a whole.

Exploratory behavior mapping of the single representative day in the park and playground areas showed patterns of use in the Park Zones clustered around active sports settings. In the Playground Zones, use was spread throughout the play areas on both the equipment and surfacing. Clusters of use were found around the swings, spiral slides, and ground level climbing apparatus in the active areas, and on the park furnishings in the gathering areas. In the Coffee Park playground behavior map, adults were found using the ramp accessible

play structure, in contrast with none actually being on the play structure in the other playgrounds. This finding is supported by the lower Child/NonChild ratios on the Coffee Park play structure in comparison with the other playgrounds. It gives further support to the value UD contributes to the play environment by getting adult participation in play along with their children.

In terms of measured metabolic equivalents or METs, the Park Zones had 53% of the total METs with trail use having the highest proportion of active users making a large contribution to overall recorded physical effort in terms of METs. The Playground Zones contributed 47% of the measured activity in the park rivaling the active sports areas in METs expended. The Case playground at Coffee Park had the largest MET numbers of any of the behavior settings in all of the parks. In terms of overall METs per acre, the Park Zones had 2.7 METs/acre per observation, in contrast with 26.6 METs/acre per observation in the Playground Zones, or nearly 10 times the METs/acre in the Playground Zones! This demonstrates the contribution playgrounds can make to physical activity levels in outdoor recreation environments providing a substantial impact on the practical matter of park planning and design in the endeavor to provide public facilities with the potential of improving public health.

Evaluation of the Primary Aim and Hypothesis showed the mean use per observation had nearly twice the use at the Coffee Park playground, the Case which employed UD, over the Comparisons which employed AD. Significance was confirmed by ANOVA and the majority of the multivariate analysis. As a result of the analysis, the observation data conducted in the process of this research has yielded solid support for the primary hypothesis of UD as a positive contributor to increased playground use and therefore being an indicator of attractiveness. The hypothesis is reinforced by much of the qualitative and exploratory data exemplified by the MET scores in the Coffee Park playground being the highest of any of the use areas. The result of this

demonstrated attractiveness is increased use and more physical activity expended, making a contribution to improved health because parents and children that are in the park and using the playground are both engaging in healthy physical activity and not on the couch watching television or playing computer games. These findings are tempered by the previous acknowledgment of the limited single environment within which the research has been conducted.

While the primary aim and hypothesis found support and the secondary aims looked at the additional contribution physical amenities make to physical activity, more questions were generated for future research. At what level is there support for the hypothesis across a variety of cities and socioeconomic settings? Are the qualitative findings significant and how generalizable are they? Each of the observed findings including the primary hypothesis and the qualitative observations is accompanied by a myriad of research questions and potential future studies addressing the contribution of play to healing, active living, outdoor physical activity, inclusion, universal design, perception, and the contribution physical elements make in the outdoor park environment. It is the expressed desire of this research to contribute to the advocacy of inclusive play environments by showing evidence of their value to the general public and public health in support of policies that promote building and funding play environments that employ Universal Design in more widely inclusive play environments.

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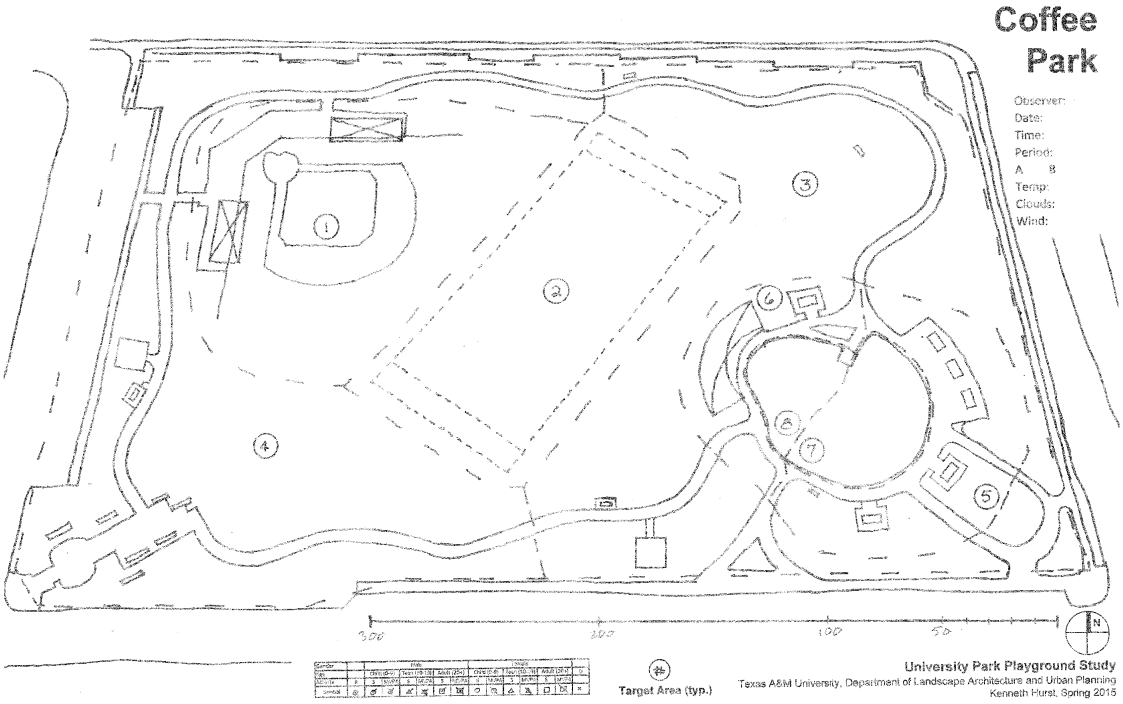
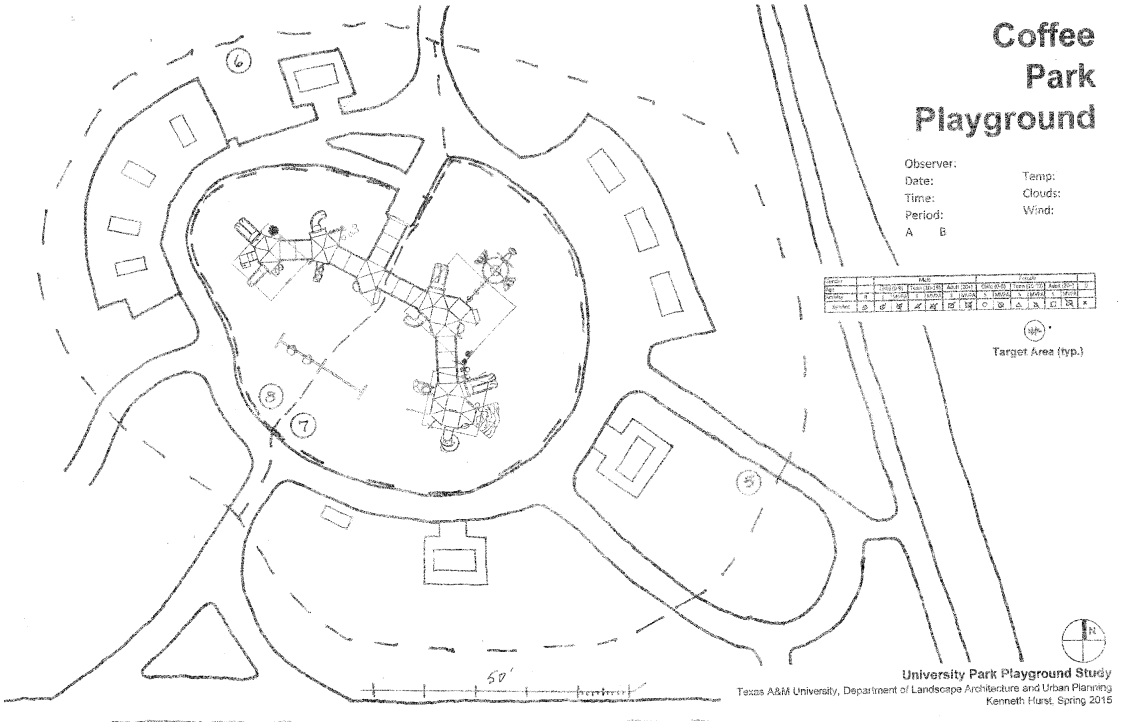
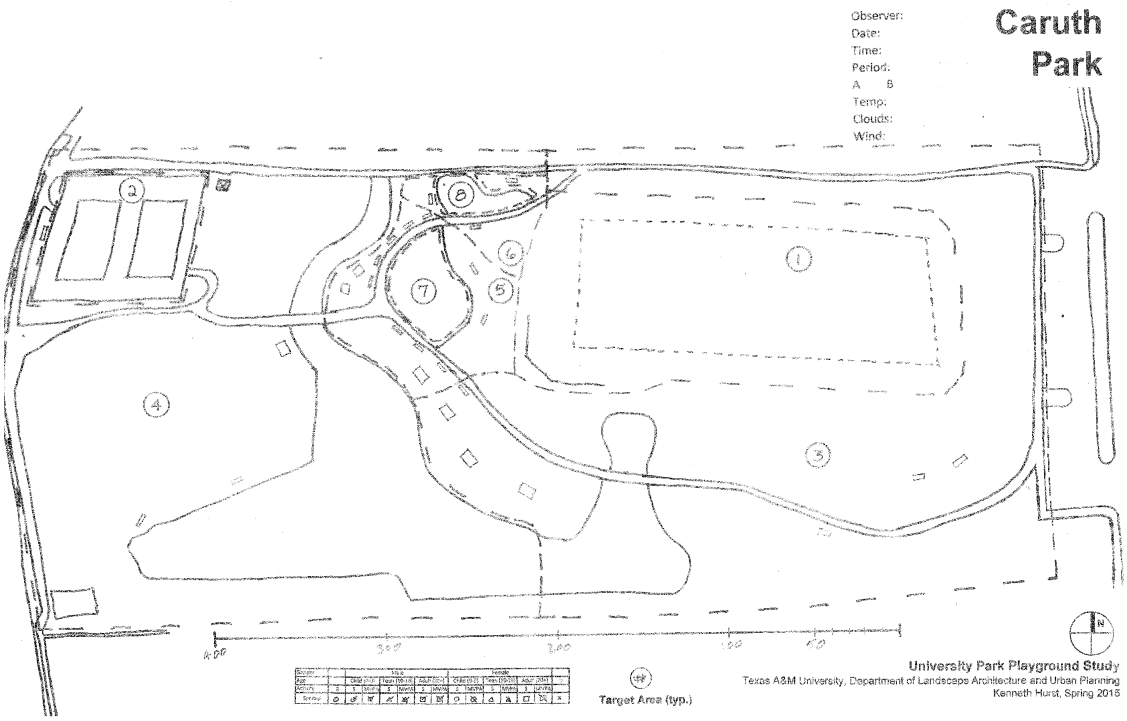
APPENDIX ONE: OBSERVATION INSTRUMENTS

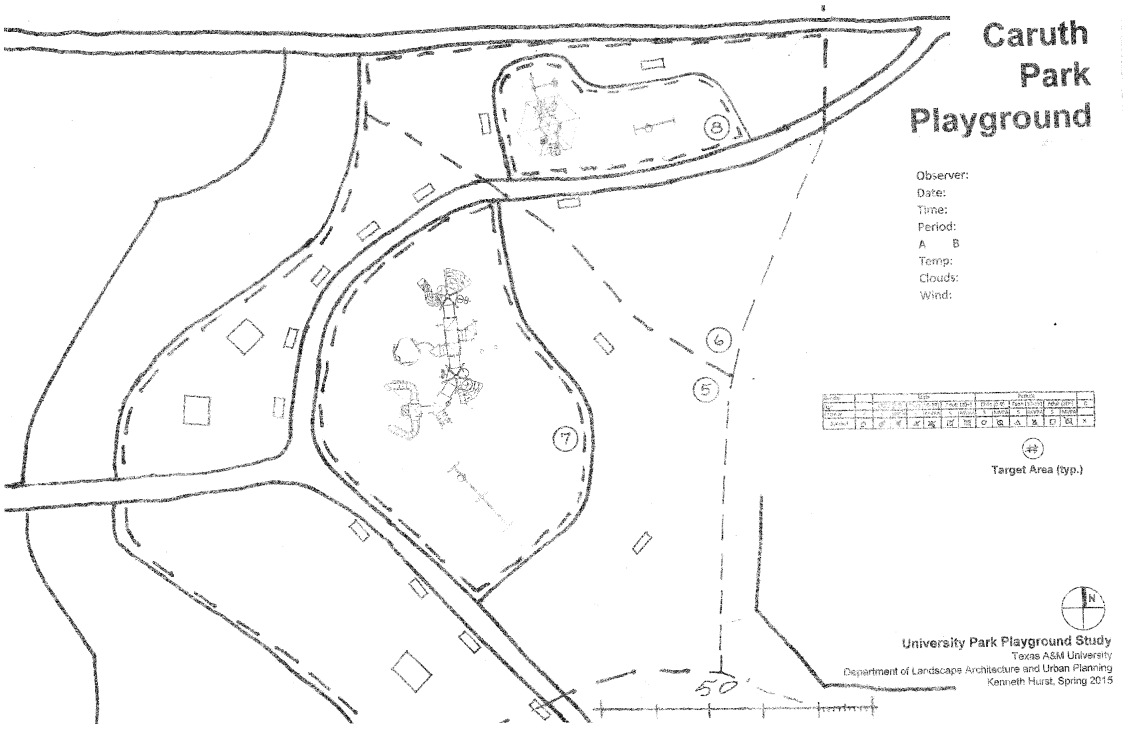
1.1a: Coffee Park, Park and Playground



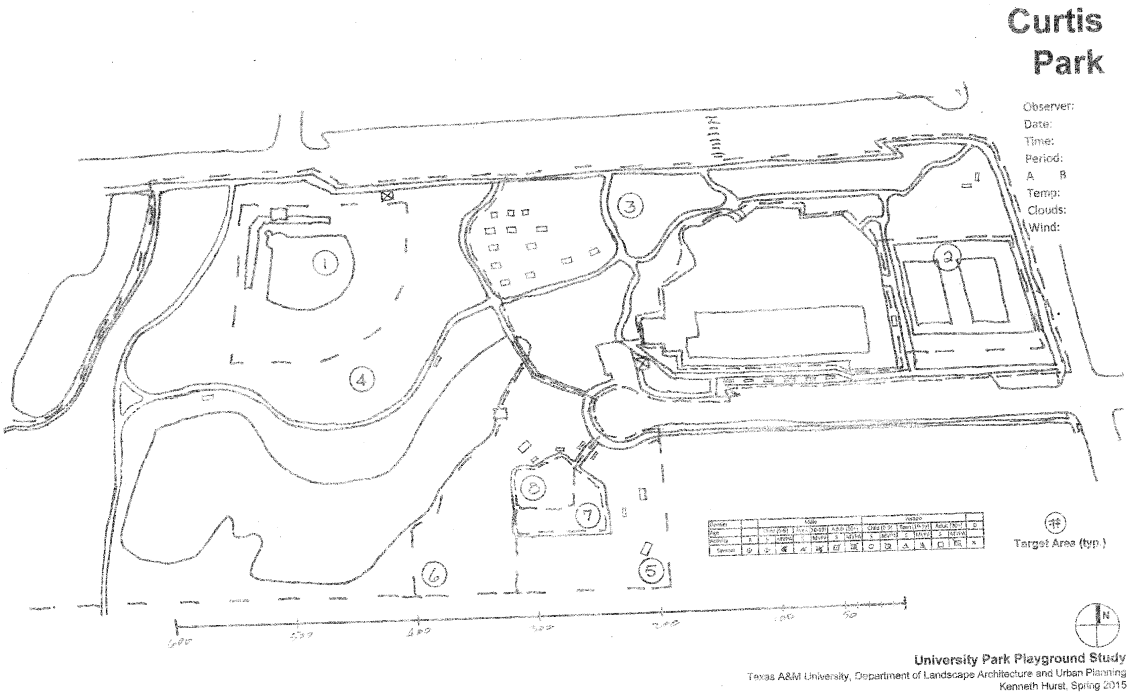


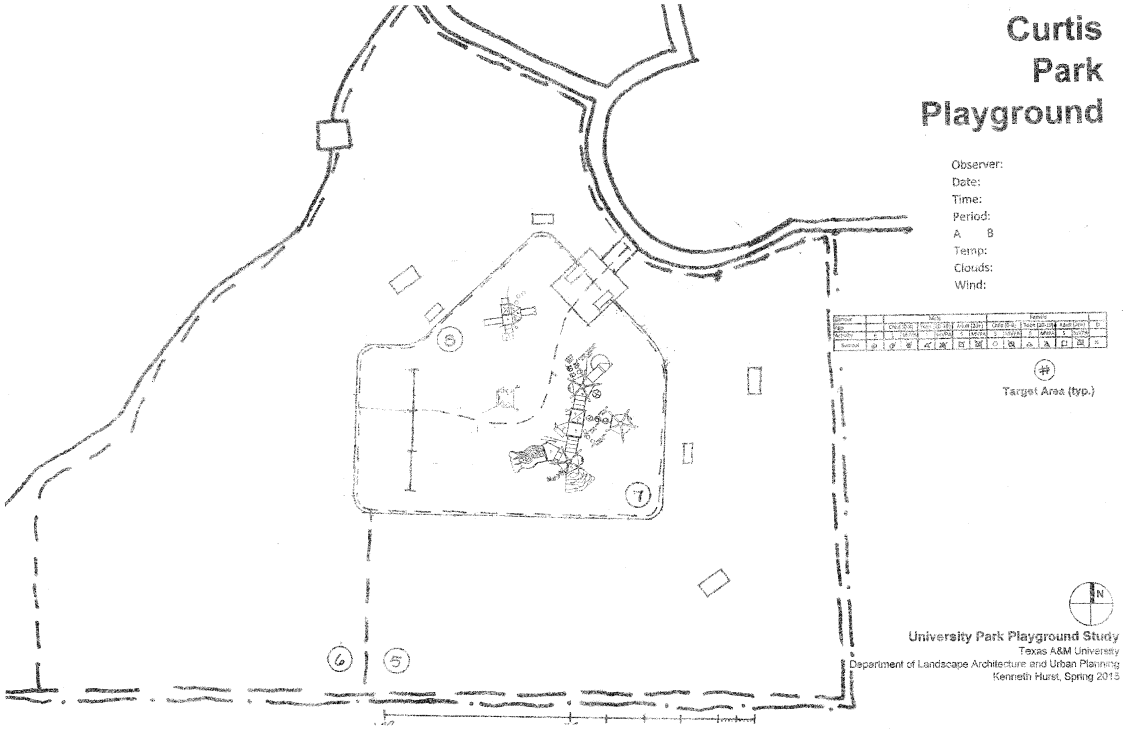
1.2a: Caruth Park, Park and Playground





1.3a: Curtis Park, Park and Playground





1.4a: Observation Summary Form

Park User Observation Summary, University Park, Texas

Date: Time: Temp: Cloud Cover: Wind: Observer:

Period: ☐ Dawn ☐ Morning ☐ Lunch ☐ Afternoon ☐ Evening ☐ A ☐ B

Park: ☐ Coffee ☐ Caruth ☐ Curtis

		Stroll	pms	pma	pfs	pfa	sms	sma	sfs	sfa	tms	tma	tfs	tfa	ams	ama	afs	afa	Dog
Obs	TA	⊙	⊘	⊗	○	◔	◪	⊠	◗	◕	◬	✳	△	◭	◪	⊠	□	◱	×
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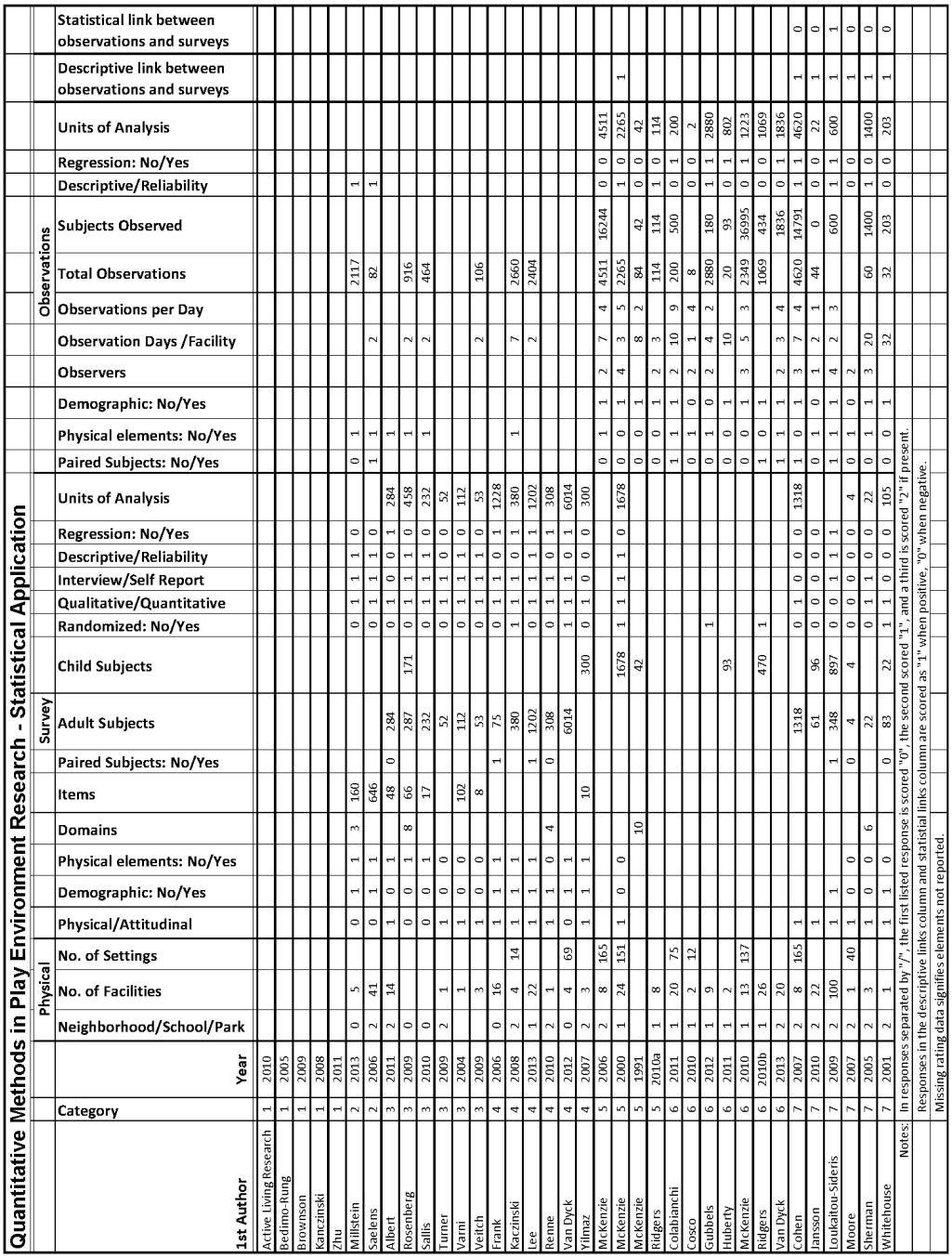
APPENDIX TWO: TABLES

2.1a: Measurement in Play Environment Research



Quantitative Methods in Play Environment Research - Statistical Application

1st Author		Year	Category	Physical: Neighborhood/School/Park	Physical: No. of Facilities	Physical: No. of Settings	Physical/Attitudinal	Demographic: No/Yes	Physical elements: No/Yes	Domains	Items	Paired Subjects: No/Yes	Survey: Adult Subjects	Child Subjects	Randomized: No/Yes	Qualitative/Quantitative	Interview/Self Report	Descriptive/Reliability	Regression: No/Yes	Units of Analysis	Paired Subjects: No/Yes	Physical elements: No/Yes	Demographic: No/Yes	Observers	Observation Days /Facility	Observations per Day	Observations: Total Observations	Observations: Subjects Observed	Descriptive/Reliability	Regression: No/Yes	Units of Analysis	Descriptive link between observations and surveys	Statistical link between observations and surveys
Active Living Research	1	2010																														
Bedimo-Rung	1	2005																														
Brownson	1	2009																														
Kanczinski	1	2008																														
Zhu	1	2011																														
Millstein	2	2013		0	5		0	1	1	3	160				0	1	1	0			0	1				2117		1				
Saelens	2	2006		2	41		0	1	1		646				0	1	1	0			1	1			2	82		1				
Albert	3	2011		2	14		1	0	1		48	0	284		0	1	0	0	1	284		1										
Rosenberg	3	2009		0			0	0	1	8	66		287	171	0	1	1	1	0	458		1			2	916						
Sallis	3	2010		0			0	0	1		17		232		0	1	1	1	0	232		1			2	464						
Turner	3	2009		2	1		1	0	0				52		0	1	1	0	0	52												
Vanni	3	2004			1		1	0	0		102		112		0	1	1	1	0	112												
Veitch	3	2009			3		1	0	0		8		53		0	1	1	1	0	53					2	106						
Frank	4	2006		0	16		1	1	1			1	75		0	1	1	0	1	1228												
Kaczinski	4	2008		2	4	14	1	1	1				380		1	1	1	0	1	380		1			7	2660						
Lee	4	2013		1	22		1	1	1			1	1202		0	1	1	1	1	1202					2	2404						
Renne	4	2010		2	1		1	1	0	4		0	308		0	1	1	0	1	308												
Van Dyck	4	2012		0	4	69	0	1	1				6014		1	1	1	0	1	6014												
Yilmaz	4	2007		2	3		1	1	1		10			300	0	1	0	0	0	300												
McKenzie	5	2006		2	8	165															0	1	1	2	7	4511	16244	0	0	4511		
McKenzie	5	2000		1	24	151	1	0	0					1678	1	1	1	0	1678		0	0	1	4	3	5	2265		1	0	2265	1	
McKenzie	5	1991								10				42							0	0	1		8	2	84	42	0	0	42		
Ridgers	5	2010a		1	8																0	0	1	2	3		114	114	1	0	114		
Colabianchi	6	2011		1	20	75															1	1	1	2	10	9	200	500	0	1	200		
Cosco	6	2010		1	2	12															0	1	0	2	1	4	8		0	0	2		
Gubbels	6	2012		1	9																0	1	0	2	4	2	2880	180	1	1	2880		
Huberty	6	2011		1	2									93							0	0	1		10		20	93	0	1	802		
McKenzie	6	2010		1	13	137															0	0	1	3	5	3	2349	36995	0	1	1223		
Ridgers	6	2010b		1	26									470	1						1	0	1				1069	434	0	0	1069		
Van Dyck	6	2013		2	20																1	1	1	2	3	4		1836	0	1	1836		
Cohen	7	2007		2	8	165	1						1318		0	1	0	0	0	1318	1	0	1	3	7	4	4620	14791	1	1	4620	1	0
Jansson	7	2010		2	22		1						61	96	0	0	0	0	0		0	1	0	1	2	1	44	0	0	0	22	1	0
Loukaitou-Sideris	7	2009		2	100		1	1				1	348	897	0	0	1	1	1		1	1	1	4	2	3		600	1	1	600	1	1
Moore	7	2007		2	1	40	1	0	0			0	4	4	0	0	0	0	0	4	0	1	0	2					0	0		1	0
Sherman	7	2005		2	3		1	0	0	6			22		0	1	1	0	0	22	0	1	1	3	20		60	1400	1	0	1400	1	0
Whitehouse	7	2001		2	1		1	1	0			0	83	22	1	1	0	0	0	105	0	0	1		32		32	203	0	0	203	1	0

Notes: In responses separated by "/", the first listed response is scored "0", the second scored "1", and a third is scored "2" if present.
Responses in the descriptive links column and statistial links column are scored as "1" when positive, "0" when negative.
Missing rating data signifies elements not reported.

6.2.1a: Mean Users per Observation by Percent Child

	COMBINED (n=210)	COFFEE (Case) (n=70)	CARUTH (Comparison) (n=70)	CURTIS (Comparison) (n=70)
PARK (TA 1-4)	16.1	10.2	19.4	18.6
Child	6.1	4.6	7.2	6.5
NonChild	10.0	5.6	12.1	12.1
Percent Child	37.9%	45.0%	37.1%	34.9%
PLAYGROUND (TA 5-8)	13.7	19.6	12.1	9.3
Child	7.8	11.5	6.7	5.1
NonChild	5.9	8.0	5.4	4.2
Percent Child	56.9%	58.7%	55.4%	54.8%

6.2.2a: Mean Percent Active Users per Observation by Age Group

	COMBINED (n=210)	COFFEE (Case) (n=70)	CARUTH (Comparison) (n=70)	CURTIS (Comparison) (n=70)
PARK (TA 1-4)				
Child				
Active	4.9	3.7	5.6	5.3
Sedentary	1.2	1.0	1.6	1.1
Percent Active	80%	79%	77%	82%
NonChild				
Active	5.4	2.3	7.2	6.6
Sedentary	4.6	3.3	4.9	5.5
Percent Active	54%	41%	59%	54%
PLAYGROUND (TA 5-8)				
Child				
Active	6.2	9.4	5.3	3.9
Sedentary	1.6	2.1	1.4	1.2
Percent Active	80%	82%	79%	76%
NonChild				
Active	2.9	4.0	2.7	2.0
Sedentary	3.0	4.0	2.7	2.2
Percent Active	49%	50%	50%	48%

6.2.3a: Percent Users by Age Group, Gender and Physical Activity

	COMBINED (n=210)		COFFEE (Case) (n=70)		CARUTH (Comparison) (n=70)		CURTIS (Comparison) (n=70)	
	Mean	%*	Mean	%*	Mean	%*	Mean	%*
PARK (TA 1-4)								
Child	*18.30*		*4.62*		*7.23*		*6.45*	
Male	12.42	68%	4.03	87%	4.20	58%	4.19	65%
Active	10.13	82%	3.32	82%	3.22	77%	3.59	86%
Sedentary	2.29		0.71		0.98		0.60	
Female	5.88		0.59		3.03		2.26	
Active	4.44	76%	0.34	58%	2.38	79%	1.72	76%
Sedentary	1.44		0.25		0.65		0.54	
NonChild	*29.85*		*5.61*		*12.13*		*12.11*	
Male	15.21	51%	2.91	52%	6.10	50%	6.20	51%
Active	8.60	57%	1.45	50%	3.59	59%	3.56	57%
Sedentary	6.61		1.46		2.51		2.64	
Female	14.64		2.70		6.03		5.91	
Active	7.50	51%	0.84	31%	3.62	60%	3.04	51%
Sedentary	7.14		1.86		2.41		2.87	
PLAYGROUND (TA 5-8)								
Child	*23.36*		*11.54*		*6.72*		*5.10*	
Male	11.67	50%	6.14	53%	3.16	47%	2.37	46%
Active	10.30	88%	5.47	89%	2.76	87%	2.07	87%
Sedentary	1.37		0.67		0.40		0.30	
Female	11.69		5.40		3.56		2.73	
Active	8.30	71%	3.94	73%	2.53	71%	1.83	67%
Sedentary	3.39		1.46		1.03		0.90	
NonChild	*17.65*		*8.01*		*5.42*		*4.22*	
Male	4.36	25%	1.97	25%	1.33	25%	1.06	25%
Active	2.35	54%	1.06	54%	0.68	51%	0.60	57%
Sedentary	2.02		0.91		0.65		0.46	
Female	13.29		6.04		4.09		3.16	
Active	6.40	48%	2.92	48%	2.04	50%	1.44	46%
Sedentary	6.89		3.12		2.05		1.72	

* Time (T) total as a percent of day total

Table 6.10a: Stata "countfit" Test and Fit Statistics

PRM	BIC=	2528.535	AIC=	2508.452	Prefer	Over	Evidence
vs NBRM	BIC=	1491.111	dif=	1037.423	NBRM	PRM	Very strong
	AIC=	1467.682	dif=	1040.770	NBRM	PRM	
	LRX2=	1042.770	prob=	0.000	NBRM	PRM	p=0.000
vs ZIP	BIC=	2130.494	dif=	398.041	ZIP	PRM	Very strong
	AIC=	2090.329	dif=	418.123	ZIP	PRM	
	Vuong=	4.672	prob=	0.000	ZIP	PRM	p=0.000
vs ZINB	BIC=	1424.613	dif=	1103.922	ZINB	PRM	Very strong
	AIC=	1381.100	dif=	1127.352	ZINB	PRM	
NBRM	BIC=	1491.111	AIC=	1467.682	Prefer	Over	Evidence
vs ZIP	BIC=	2130.494	dif=	-639.383	NBRM	ZIP	Very strong
	AIC=	2090.329	dif=	-622.647	NBRM	ZIP	
vs ZINB	BIC=	1424.613	dif=	66.499	ZINB	NBRM	Very strong
	AIC=	1381.100	dif=	86.581	ZINB	NBRM	
	Vuong=	4.063	prob=	0.000	ZINB	NBRM	p=0.000
ZIP	BIC=	2130.494	AIC=	2090.329	Prefer	Over	Evidence
vs ZINB	BIC=	1424.613	dif=	705.881	ZINB	ZIP	Very strong
	AIC=	1381.100	dif=	709.228	ZINB	ZIP	
	LRX2=	711.228	prob=	0.000	ZINB	ZIP	p=0.000

APPENDIX THREE: PILOT STUDY

Landscape Research Record No.2

THE UNIVERSAL ATTRACTIVENESS OF UNIVERSALLY ACCESSIBLE PLAY ENVIRONMENTS: A PILOT STUDY

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1 ABSTRACT

This informal systematic observation study was undertaken in spring 2012 exploring the hypothesis that playgrounds designed to higher universal accessibility standards, are more attractive to children of all abilities and to the general population, than are those designed simply meeting minimum ADA Standards. User counts were conducted in the playgrounds of seven parks in a single community. One park had a highly accessible playground, built using universally accessible concepts, having ramps and other features significantly exceeding ADA. The six comparison parks had playgrounds designed to meet ADA minimums. All seven parks were located in a suburban Dallas, Texas community with similar socio-demographics and similar park attributes such as size, amenities, and maintenance qualities. Findings showed the universally accessible playground had use ratios of children per play event being over three times the mean use ratios of the other playgrounds. These findings appeared supportive of the hypothesis that a playground built to the higher standards of universal accessibility, can attract more use by children and by all users than playgrounds meeting only minimum ADA standards. Despite the pilot nature of this study, it brings attention to the potential and understudied value universally accessible playgrounds may contribute to stimulating outdoor play activity and furthering the benefits of healthy active living for all children. Formal research is being developed using more rigorous protocols that combine analysis of physical conditions, user observations and user surveys to further test the hypothesis and support policies and guidelines encouraging the implementation of universally accessible play environments.

1.1 Keywords

accessibility, children, fitness, park, playground

2 BACKGROUND

A pilot study was conducted to explore the hypothesis that playgrounds designed to higher universal accessibility standards are more attractive to children of all abilities, and to the general population, than those designed simply meeting minimum accessibility standards. The study is an informal systematic observation study counting users of playgrounds in seven public parks within one community. It focuses on the issue of universal accessibility in playgrounds as a potentially important factor influencing play activities among children and families without special needs in addition to those having special needs.

Research has shown that outdoor play and active living can make a substantial contribution to the lives of children and adults alike. Frequent and regular physical activity can increase longevity, well-being, and reduce the risk of obesity and many other chronic health problems (Active Living Research, 2010). Play is a conduit for physical activity especially among children, and has been found to bring many additional benefits such as stress reduction and intellectual development (Active Living Research, 2010). Neighborhood parks, outdoor recreation facilities and playgrounds can help people of all backgrounds to include a more active lifestyle in their weekly routines (Active Living Research, 2010).

In 1991, the Americans with Disabilities Act (ADA) brought an increased awareness of designing for people with disabilities giving impetus to design for accessibility and play for children with special needs. Research has shown considerable support for the value of play promoting socialization in children of all abilities. However, there is little quantitative evidence regarding the general popularity of play environments designed with a focus on inclusion.

2.1 Play and Child Development

"Play is the child's work. The world is his laboratory, and he is the scientist" (Friedberg,

1970). Good design creates a child's world where the child is at home and the adult is the outsider. Design should create the opportunity to steer a child's exploratory process toward creative thinking for imaginative experiences. Spatial elements of masses and voids and the equipment that defines them can be used to make a variety of links to further enhance the choices in play and increase the creative element of spontaneous choices for the child (Friedberg, 1970).

Childhood involves a tremendous amount of learning and growth. Play can be a medium for development as a child gains information about themselves, their bodies, their friends and the new world in which they live. At the fundamental level, growth revolves around the four dimensions of social, emotional, physical and cognitive development. Each of these dimensions contributes to the overall development of a child (Thompson, 1992).

Spontaneous, free play in children is one of the most important and most beneficial types of play (Frost, 2004). Free play has five dimensions identified by play scholars and researchers. It is primarily voluntary, allowing participants to enter or leave at will. Free play is spontaneous; at any time it can be changed by any of the players. It is imaginary, involving a pretend element that is different from everyday life. Free play is engaging; players are separated from other activities as they engage in the play activity. The fifth dimension is simply being fun, pleasant and enjoyed by the participants (Frost, 2004).

Many health care professionals and educators consider play to make important contributions to a child's development. It is a process where children can develop through interaction with their physical and social environment on their own terms. In free play, children's reading readiness and sociometric status among their peers is readily seen through their play behaviors (Pellegrini, 1988).

Children aren't the only ones that exhibit the behaviors of play. Animals from mammals down through birds, reptiles and fish have been observed in play. Play has been shown to allow animals to prepare themselves for changing conditions in a continuously evolving environment by testing their abilities without threatening their own well-being. Individual animals that play have been found to have more brain development than those who don't (Brown, 2009). In animals that don't play, neural growth has been found to be in only one part of the brain as opposed the whole brain growth in those that play. Essentially, play has been shown to stimulate brain growth, add to intelligence, and improve survival through adaptability (Brown, 2009).

2.2 Accessibility and Playgrounds

Inclusion in all aspects of society is becoming recognized as the new standard of social integration in the developed world. Over the years, people with physical limitations in general and children specifically have lived in a socially restricted minority group that imposes restrictions on the activity and interactions of people with physical and/or cognitive impairments that result in an undermining of their psycho-emotional state of well-being. From this point of view, a disability is a socially imposed restriction based on a certain physical impairment significantly limiting a child's social interactions with their peers (Burke, 2012).

While the value of play has been demonstrated as a critical part of a child's life and development, it is important to recognize that playgrounds don't lead to positive outcomes for all children. In many environments children with physical disabilities have become marginalized and often their parents become marginalized as well. In an effort to recognize that people having physical impairments and disabilities are 'people first' before their disability, it is recommended that a 'person first' terminology and language be used when discussing children with different physical conditions such as autism or the need to use a mobility device such as a wheel chair (Jeanes, 2012).

An important element of play and the play environment is that it becomes a medium for communication and interaction with peers. Children of all abilities have reported the playground as a place where they can have privacy, especially from adults, and interact with their friends. Just sitting around and talking with peers has been reported as a valuable activity. Children express the importance of the conversations being private interactions among children without adult presence. In the mind of many children of all abilities, the playground is as much a social space as a place for activity (Prellwitz, 2007).

High quality inclusive play environments are needed to foster development in children of all abilities in an effort to reverse the trend of the disenfranchisement of those with different physical impairments. In response to the need for inclusion, the concept of universal design in play goes beyond the minimum statutory requirements of the ADA Standards for Accessible Design. The concept seeks to design environments that are usable for all people, of all abilities, without the need for adaption. The resulting universally designed environment has

the potential to encourage more use by people of all abilities to link children with peers and parents with parents in a recreational setting benefiting adults and children alike (Moore, 2007).

Some basic elements of providing play environments for people of all abilities include removing physical barriers by providing a good accessible route, making sure play features and site amenities are available to everyone. The effect of limiting accessible play elements to a single specially designed space simply reinforces the social segregation that universal design seeks to overcome (Jeannes, 2012). This discussion has focused on children with disabilities. There are many parents and care givers of able bodied children that need to use mobility devices and who would like to or need to be able to accompany their children to the playground. The inclusive environment seeks to include parents and caregivers who have physical disabilities as well as children (Goltsman, 2011).

2.3 Regulatory Framework for Accessible Playgrounds in the US

There has been much work done in the last ten years to develop accessibility standards around the world. In the United States, the Americans with Disabilities Act (ADA) was enacted in 1990. The original accessibility rules found in the 1991 Americans with Disabilities Act Accessibility Guidelines (ADAAG) recognized the need but did not include any specifications for recreation areas or playgrounds. The first rules for accessibility in playgrounds were adopted by the U.S. Access Board in October, 2000.

In 2010, the Justice Department adopted a set of standards for accessibility, the "2010 Standards for Accessible Design". The new Standards generally follow the Access Board rules, devoting two full chapters to play areas themselves, defining minimum requirements for accessibility of play area ground surfacing, play structure accessibility, and accessibility requirements for play elements. The new Standards became a statutory requirement for all facility design March 15, 2012 (U.S. Department of Justice, 2010).

The first step to providing accessible facilities, including playgrounds, is the need for an accessible route to the facility, and within the facility to the play events. To access play structures in smaller playgrounds, the Standards allow a transfer platform. A child with mobility impairments who has some ambulatory capability but uses a wheelchair, can challenge their abilities by transferring from the wheel chair to the platform and onto the structure. The Standards also define elevated play and ground level play, the need for 50% of elevated play being on an accessible route, required numbers of ground level events, accessible play surfacing, and when ramps onto the play structure are needed (U.S. Department of Justice, 2010).

The concept of universal design goes beyond the minimums of ADA. The minimum standards only require one-half of the play elements to meet accessibility requirements, transfer platforms are allowed in smaller playgrounds and accessible loose fill surfacing is allowed. Loose fill surfacing can shift to form humps and rolls if not frequently maintained thereby limiting accessibility. Going beyond the minimum standards includes making all or nearly all play features accessible, providing ramps to the majority of play features, and using highly accessible unitary surfacing on the ground level. Universally designed playgrounds should be designed to give children and people of all abilities access to all elements in a play environment offering play opportunities for those of all abilities (Goltsman, 2011).

2.4 Case Study

The case study of Kids Together Playground in Maria Dorrel Park in Cary, North Carolina provides a theoretical foundation for the pilot study. The methodology used a mixed-method design that combines user observations in behavior mapping with tracking the activities of individual families having a child with a disability, and interviews with the families. The strength of the methodology was the use of behavior mapping to identify and graphically locate the numbers of children using different elements of the play environment including the play equipment, pathways and gathering areas (Moore, 2007).

The playground opened in 2000 as a destination facility occupying approximately 2 acres having a reported construction cost of approximately $1M. The park is characterized by three large circular pathways that intersect with each other to form the framework of the playground. The research divides the play environment into seven functional use zones that are further subdivided into 12 setting types. A total of 40 settings are identified, including play areas having different types of manufactured equipment, circulatory spaces, gathering spaces, open lawn areas, and a large ground level sculptural dragon (Moore, 2007).

Being a destination facility and much larger than the playgrounds in University Park, Kids Together Park is a good example of a best practices facility. Among the seven functional use zones, the most popular zone was the one having the

horizontal play structure that was ramp accessible. This most popular zone also had the most setting types within it. The study considered the number and combination of play settings along with the higher level of accessibility as contributors to the higher attraction. The research identifies the promise of quantitative analysis and more extensive data sets as a future contribution to understanding the dynamics of behavior in the built environment (Moore, 2007).

3 PURPOSE

The goal of the study was to explore a hypothesis that a playground built to the highest standards of accessibility in terms of the standards of ADA and professional practice will attract more use by all children than playgrounds designed to only meet minimum ADA standards. There is a growing body of evidence reflecting the impact outdoor open space and public parks have in facilitating active living and increased levels of physical activity, with a potential benefit of improving health, reducing obesity, and reducing the cost of public healthcare (Active Living Research, 2010).

There is little research that has examined the contribution of specific amenities to public park use or promotion of physical activity (Kaczynski, 2008). Along with this lack of research is a reciprocal lack of research using direct observation and detailed park evaluations to investigate associations between amenities, use, and physical activity (Colabianchi, 2011). Along with these expressed research needs, no research was found that addressed the value universally accessible facilities or play environments provide to the general public.

The pilot study has sought to fill these gaps and provide a foundation for further research. Support for the hypothesis is thought to benefit both the able bodied and people having disabilities by showing the value universal accessibility has beyond the population of the physically challenged. This has the potential of validating expanded funding for universally accessible facilities by showing benefit to all people in the community beyond those with physical challenges while benefiting the physically challenged as well.

4 METHODS

An informal systematic observation study was undertaken in spring 2012 exploring the hypothesis that playgrounds designed to higher universal accessibility standards, going beyond the minimum standards of ADA, are more attractive to children of all abilities and to the general population, than are those designed simply meeting minimum ADA Standards. User counts were conducted in the playgrounds of seven parks. One had a highly accessible playground with ramps and other features significantly exceeding ADA, the six other playgrounds were designed to meet statutory ADA minimums.

4.1 Study Setting

This study involved one case and six comparison playgrounds located in the City of University Park, Texas. University Park is a small, 3.8 square mile city, founded in what was rural Dallas County in 1915 and formally incorporated in 1924 (University Park, 2013). It is a bedroom suburb, built around a major private university, approximately five miles north of downtown Dallas, dominated by single family housing of approximately 8,600 homes with a population of 23,500 residents. It is one of the most highly educated communities in the country with 72% of the residents over 25 years of age having college or advanced degrees and property values in the city are among the highest in the nation (University Park, 2013).

The City Parks and Recreation Department operates and maintains eight neighborhood parks in residential areas of the community. Seven of the parks have playgrounds, all built to meet the ADA standards. During an informal interview, the director of parks and recreation had stated that the playground at Coffee Park built in 2009 to the highest standards of ADA accessibility, was reported to have unusually high user traffic. Figure 1 shows the play environment in Coffee Park which is the *case* playground in this study, with the six *comparison* playgrounds built to meet the minimum ADA requirements.

The figure also illustrates the similar qualities of the seven playground environments. While they vary in age, each meet current playground safety and ADA standards, they are well maintained, and are kept in good repair. The playgrounds are all built using equipment from the same playground manufacturer being of the same line and specifications using the post and platform style. Of the playgrounds, six use transfer accessibility and meet the basic ADA standards while the case playground at Coffee Park is designed to significantly exceed ADA standards.

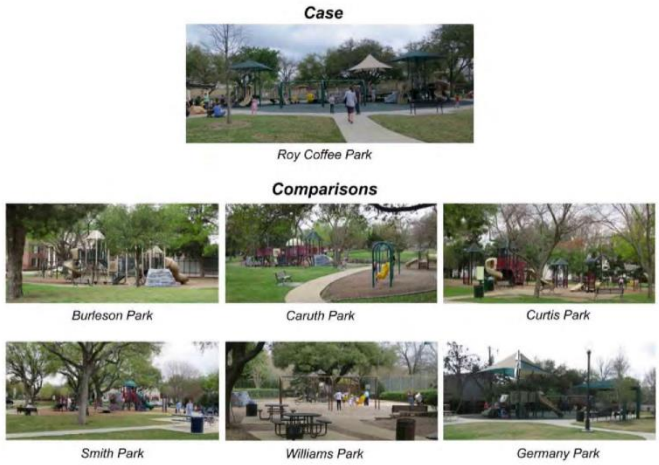

Figure 1. Coffee Park Playground (Case) and Six Comparison Playgrounds, Photos by First Author

The setting presents advantages for this empirical study because the parks are all located in predominantly single family neighborhoods with apparent homogeneous populations allowing to at least partially control for the influence of demographic variables. Functionally, they all have accessible routes to the playgrounds, drinking fountains and toilets, and are within a couple miles of each other. Park features include large mature trees, and a variety of attractive amenities such as water features, tennis courts, picnic areas, and active sports fields. For an informal study, this provides a setting where there is reasonable similarity between a number of environmental variables. Figure 2 shows the location of the parks illustrating their close proximity to one another.

To begin quantifying the differences and similarities between the parks and the playgrounds, some of the basic physical characteristics and demographics have been compiled. Table 1 shows the number of play events, playground square footages, park acreages, surfacing type and demographics within a ¼ mile radius of each park. Data is shown for Coffee Park and each comparison park. Averages are reported for the for the six comparison parks excluding Coffee Park.

All of the parks are under 10 acres and within the size of a neighborhood park. They range from Curtis Park being the largest park at 9.5 acres to Smith Park being the smallest at 1.9 acres. Coffee Park, at 4.3 acres is slightly below the mean of 5.8 acres. Demographically, the neighborhood area within ¼ mile of Coffee Park is above the mean of the comparison parks in the number of households and total population but nearly the same in terms of child population as reported by the Esri Community Analyst GIS mapping software (ESRI, 2013). Racial composition of the neighborhoods is very consistent having a mean of 95.5 percent white, with the Coffee Park neighborhood being 95.4 percent white.

The range of numbers of play events in each of the seven playgrounds was a high of 40 at Coffee Park and a low of 16 at Smith Park and Germany Park. The average or mean number of play events was 26 including all seven parks and a mean of 24 in the six comparison parks. Among the seven study parks, the playgrounds at Curtis Park, Caruth Park and Coffee Park, had play event counts above the mean, and were the most comparable in terms of size and numbers of play events.

The square footage (s.f.) of the play areas range from a high of 7,900 s.f. at Caruth Park to a low of 2,900 s.f. at Germany Park with a mean square footage for all the parks of 5,833. This places Coffee Park, at 6,400 s.f., about 10% above the mean. Surfacing used on the playgrounds consisted of five having loose fill engineered wood fiber (EWF) surfacing and two with unitary poured in place (PIP) surfacing.

Figure 2: Coffee Park and Six Comparison Parks

Table 1. Physical and demographic conditions

	Play Events	Playground S. F.	Play Surface*	Park Acres	¼ Mi. DEMOGRAPHICS House-holds	Children Under 10	TOTAL Population	% White
CASE PLAYGROUND (n=1)								
Coffee Park	40	6,400	PIP	4.3	567	155	1,147	95.4
COMPARISON PLAYGROUNDS (n=6)								
Mean	24	5,833		5.8	337	152	1,034	95.5
COMPARISON PLAYGROUNDS: Individual counts								
Burleson Park	24	6,500	EWF	5.0	463	216	1,749	91.5
Curtis Park	32	5,700	EWF	9.5	428	177	1,173	96.2
Caruth Park	37	7,900	EWF	7.1	352	190	1,106	97.6
Smith Park	16	5,500	EWF	1.9	308	158	958	97.4
Williams Park	19	6,500	EWF	4.8	68	18	178	94.9
Germany Park	16	2,900	PIP	6.5	404	151	1,039	95.1

* PIP: Poured in place unitary surface; EWF: Engineered wood fiber loose fill surface
** 2012 Estimate from ESRI

The EWF meets the basic requirements of ADA while the PIP goes beyond the standards for a higher degree of accessibility. Parks with PIP surfacing are Coffee Park and Germany Park.

4.2 Data Collection

The principal investigator (PI) undertook a non-random visual count of the users of the playgrounds at each of the seven parks in 2012. Each of the parks was visited on a six mile driving circuit where all of the seven parks could be checked individually within an hour's time. Users of the playground environment were counted at each facility and recorded as either children or adults. Teenagers (children over 12 years) were only observed in a few instances congregating separately and were reported as adults. The playground environment was considered to include everyone in the direct vicinity of the playground, including those using surrounding grounds and picnic tables. There was no formal definition of distance from the play area but it was clear who was in the area specifically to use the playground facility. These people were generally within 50 to 100 feet of the playground border. As a result, people of all ages who were on the playground and in the playground environment were counted as shown in Table 2.

Table 2. User counts of case and comparison playgrounds from six observations

Observation	1	2	3	4	5	6	Mean
Date	3/13/2012	3/14/2012	3/16/2012	3/16/2012	3/16/2012	3/18/2012	
Time	11:00-12:00	1:30-2:30	10:30-11:30	11:30-12:30	1:30-2:30	1:00-2:00	
Weather	68° Overcast	75° Overcast	70° Overcast	74° Overcast	75° Overcast	75° Overcast	
CASE PLAYGROUND (n=1): Coffee Park							
Children	70	47	43	50	26	18	42.3
Total Users	105	78	69	80	48	35	69.2
Children %	66.7%	60.3%	62.3%	62.5%	54.2%	51.4%	61.1%
COMPARISON PLAYGROUNDS (n=6): Mean of the six parks							
Children	11.7	6.8	8.0	7.2	6.3	3.3	7.2
Total Users	18.8	13.0	13.7	12.8	11.3	6.0	12.6
Children %	61.9%	52.6%	58.5%	55.8%	55.9%	55.6%	57.1%
COMPARISON PLAYGROUNDS: Individual counts							
Burleson Park							
Children	5	4	2	4	2	5	3.7
Total Users	10	9	3	8	4	7	6.8
Children %	50.0%	44.4%	66.7%	50.0%	50.0%	71.4%	54.4%
Curtis Park							
Children	21	12	9	14	16	1	12.2
Total Users	33	21	16	26	27	2	20.8
Children %	63.6%	57.1%	56.3%	53.8%	59.3%	50.0%	58.7%
Caruth Park							
Children	11	15	7	12	7	5	9.5
Total Users	18	27	14	22	14	11	17.7
Children %	61.1%	55.6%	50.0%	54.5%	50.0%	45.5%	53.7%
Smith Park							
Children	9	6	16	10	4	4	8.2
Total Users	17	12	24	15	7	7	13.7
Children %	52.9%	50.0%	66.7%	66.7%	57.1%	57.1%	59.9%
Williams Park							
Children	14	2	7	3	8	5	6.5
Total Users	20	4	11	5	14	9	10.5
Children %	70.0%	50.0%	63.6%	60.0%	57.1%	55.6%	61.9%
Germany Park							
Children	10	2	7	0	1	0	3.3
Total Users	15	5	14	1	2	0	6.2
Children %	66.7%	40.0%	50.0%	0.0%	50.0%	n/a	53.2%

Six rounds of user counts were performed during the spring break week in March of 2012. Observations were conducted on four separate days with a single observation on three of the days and three observations on one day. Three of the four days were weekdays and the fourth was a weekend day. The weather on all days was overcast and humid with the temperatures being between 68 and 75 degrees Fahrenheit. In all of the observations, there were 514 children and 355 adults observed in the play environments totaling 869 persons observed.

Permission to do user counts was obtained from the Director of Parks and Recreation of the City of University Park. At the time of the study, the PI had no affiliation with any university restricting the ability to analyze confounding variables. With current university affiliation, Institutional Review Board (IRB) review has been obtained and the existing research has been given exempt status by the Texas A&M University IRB.

Generalizability of this study is limited based on the cross sectional design, the numbers of observations, and the single city setting in which it was conducted. Being a pilot study, quantification of other physical and environmental factors was limited. Users were only counted in the playground environments and not in the parks as a whole. No attention was given to recording gender or race for this pilot phase of the research. No contact was made with the playground users to find out their preferences in play, travel choices or any other

attitudinal or perceptual issues. Collection of this data and its analysis will be the subject of future research.

5 FINDINGS

In an effort to create a common denominator between playgrounds of different sizes, user counts were translated into ratios of both children per play event and of all users per play event. Play events include individual elevated and ground level play elements in the playground. Overall, children made up 61.1% of total users in the case park, compared to 57.1% on average for the comparison parks, revealing that more than one in three playground users were adult. This illustrates the need to design for parents accompanying children to the play environment and parents with special needs as well. Table 3 shows the number of play events and use ratios for children and total users in each playground of the study.

The range of numbers of play events in each of the seven playgrounds was a high of 40 at Coffee Park and a low of 16 at Smith Park and Germany Park. The average or mean number of play events was 26 including all the parks and 24 for the six comparison parks. Among the seven study parks, the playgrounds at Curtis Park, Caruth Park and Coffee Park, had play event counts well above the mean, and were the most comparable in terms of size and numbers of play events. In terms of total play events, Curtis Park has 32 play events, Caruth Park has 37 play events and there are 40 play events at Coffee Park.

Of the parks in the study, Coffee Park and Germany Park had unitary poured in place surfacing. While observations show Coffee Park had the highest mean use ratio of 1.06 children per play event, Germany Park which is also the newest park in the system had a child per play event ratio of 0.21 that was among the lowest of the comparison parks in the city and was about one fifth the use at Coffee Park. Further analysis of other park elements may shed light on this relationship but the observation ratios in this study would tend to discount surfacing alone as contributing to higher use levels.

Figure 3 shows the ratios of mean numbers of children observed at each of the playgrounds per play event on the specific playground. The observations showed the playground facility at the case playground in Coffee Park, had a use ratio of 1.06 children per play event. This is higher than other parks by over three times the average of 0.30 children per play event in the six comparison parks. Of the individual parks, the two most comparable to Coffee Park in size and facility amenities, Curtis Park with 0.38 children per play event and Caruth Park with 0.26 children per play event, showed about one-third and one-quarter the Coffee Park child user ratio respectively. Among the comparison parks, Smith Park, the smallest, showed the highest user ratios of 0.51 children per play event but was still less than half that of Coffee Park. Use ratios at the remaining parks were less than one quarter of those at Coffee Park.

Table 3. Analysis

	Play Events	MEAN USER RATIOS* Children Per Event	Total Users Per Event
CASE PLAYGROUND (n=1)			
Total	40	1.06	1.73
COMPARISON PLAYGROUNDS (n=6)			
Total	144		
Average	24	0.30	0.53
COMPARISON PLAYGROUNDS: Individual counts			
Burleson Park	24	0.15	0.28
Curtis Park	32	0.38	0.65
Caruth Park	37	0.26	0.48
Smith Park	16	0.51	0.85
Williams Park	19	0.21	0.55
Germany Park	16	0.21	0.39

* Mean number of observed users in the play environment per observation, per play event.

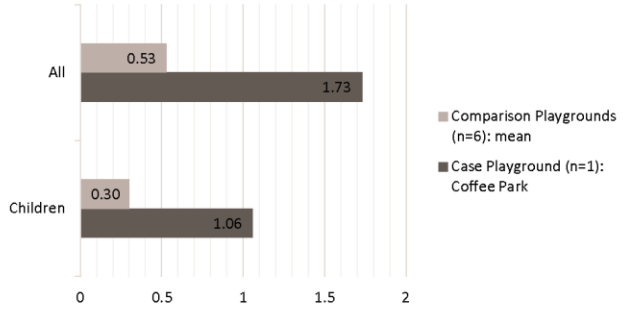

Figure 3. All Users versus Child Users per Play Event in Case and Control Playgrounds

To check the strength of the data, statistical power analysis was done using STATA version 12 with both a priori and a posteriori statistical methods. Analysis was done on the pilot study data using an alpha of 0.05 and power of 0.90. The a priori analysis returned a minimum need for 5 observations of each the case and the control parks to achieve a power of 0.90. The a posteriori analysis of the pilot study data also using an alpha of 0.05 returned statistical power of 0.9734, where a power of 0.80 is considered a large effect (Acock, 2012).

With this being a pilot study having limited numbers of observations, only simple descriptive statistics were applied. Even with the relatively low numbers of observations, the statistical power analysis shows significant strength based on the large spread between the user ratios of the case and control. The magnitude of the spread between use ratios found at Coffee Park in relation with the six comparison parks would give support to the hypothesis that highly accessible play environments have higher popularity among the general population than do play environments built only meeting statutory ADA standards.

6 CONCLUSION

These findings are consistent with one aspect of the case study findings by Moore and Cosco at Kids Together Playground in Cary, North Carolina. Among the seven functional use zones of the study, findings showed the zone having the universally accessible play structure, with ramp accessibility, was the most highly used area in the playground accounting for nearly 40% of the observed use (Moore, 2007). The higher levels of use on the universally accessible play structure is consistent with the observations in this study.

For the purposes of this article, there are two primary differences between the case study and this pilot study. The first is that Kids Together Playground, covering approximately 2 acres, is considerably larger than any of the playgrounds in University Park. It is a playground that would be considered a destination facility of proportions that are beyond that of the ordinary neighborhood or community park. In contrast, the playground at Coffee Park is of more common proportions, built in a neighborhood park setting. The second difference is that the findings at Kids Together Playground are comparing different areas of the same facility (Moore, 2007), where Coffee Park is a separate park on its own, being compared to other parks within the same metropolitan park system.

As a pilot study conducted in a single setting with limited number observations, findings from this study offer only some exploratory insights about the playgrounds' accessibility and use levels. Due to the small sample size and the lack of other available variables, only descriptive statistics are reported in this paper. Although efforts were made to carefully select the study parks to help control for other confounding factors, it is likely that factors other than the playground's ADA characteristics have some influence on the differences in the user count ratios found between the case and comparison parks. Despite these limitations, this pilot study brings attention to the potential and understudied values of highly accessible playgrounds in promoting play activities among all children, which can bring many health, developmental, and social benefits.

Further research that includes a designed research process, combining more structured observational methodologies with demographic and environmental variables, and user attitude

surveys, would be valuable to strengthen the findings. Support found in the user observations for the prime hypothesis would also tend to give support to the thought that accessible design has positive benefits to the general population as a whole. The findings have the potential of contributing to support many inclusive policies and projects in the physical environment as they relate to accessibility, benefiting everybody in the community.

7 REFERENCES

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APPENDIX FOUR: DOCUMENTS

A. Approved IRB Outcome Letter-6/2/2014

DIVISION OF RESEARCH

Research Compliance and Biosafety

TEXAS A&M UNIVERSITY

DATE: June 02, 2014

MEMORANDUM

TO: Chanam Lee
TAMU - College Of Architecture - Landscape Architecture & Urban Planning

FROM: Human Subjects Protection Program
Institutional Review Board

SUBJECT: Exempt Approval

Study Number:	IRB2014-0294M
Title:	The Universal Value of Universally Accessible Play Environments: A Pilot Study
Approval Date:	06/02/2014
Continuing Review Due:	05/01/2017
Expiration Date:	06/01/2017

Documents Reviewed and Approved:

Title
UP Letter to A&M

Consent: Waiver/alteration approved 46.116(c) or (d)

Comments: 1. Investigator was responsive to requests of the Reviewer.

This research project has been approved. As principal investigator, you assume the following responsibilities:

1. **Continuing Review:** The protocol must be renewed by the expiration date in order to continue with the research project. A Continuing Review application along with required documents must be submitted by the continuing review deadline. Failure to do so may result in processing delays, study termination, and/or loss of funding.
2. **Completion Report:** Upon completion of the research project (including data analysis and final written papers), a Completion Report must be submitted to the IRB.
3. **Unanticipated Problems and Adverse Events:** Unanticipated problems and adverse events must be reported to the IRB immediately.
4. **Reports of Potential Non-compliance:** Potential non-compliance, including deviations from protocol and violations, must be reported to the IRB office immediately.
5. **Amendments:** Changes to the protocol must be requested by submitting an Amendment to the IRB for review. The Amendment must be approved by the IRB before being implemented.
6. **Consent Forms:** When using a consent form or information sheet, you must use the IRB stamped approved version. Please log into iRIS to download your stamped approved version of the consenting instruments. If you are unable to locate the stamped version in iRIS, please contact the office.

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7. **Audit:** Your protocol may be subject to audit by the Human Subjects Post Approval Monitor. During the life of the study please review and document study progress using the PI self-assessment found on the RCB website as a method of preparation for the potential audit. Investigators are responsible for maintaining complete and accurate study records and making them available for inspection. Investigators are encouraged to request a pre-initiation site visit with the Post Approval Monitor. These visits are designed to help ensure that all necessary documents are approved and in order prior to initiating the study and to help investigators maintain compliance.
8. **Recruitment**: All approved recruitment materials will be stamped electronically by the HSPP staff and available for download from iRIS. These IRB-stamped approved documents from iRIS must be used for recruitment. For materials that are distributed to potential participants electronically and for which you can only feasibly use the approved text rather than the stamped document, the study's IRB Protocol number, approval date, and expiration dates must be included in the following format: TAMU IRB#20XX-XXXX Approved: XX/XX/XXXX Expiration Date: XX/XX/XXXX.
9. **FERPA and PPRA:** Investigators conducting research with students must have appropriate approvals from the FERPA administrator at the institution where the research will be conducted in accordance with the Family Education Rights and Privacy Act (FERPA). The Protection of Pupil Rights Amendment (PPRA) protects the rights of parents in students ensuring that written parental consent is required for participation in surveys, analysis, or evaluation that ask questions falling into categories of protected information.
10. **Food:** Any use of food in the conduct of human subjects research must follow Texas A&M University Standard Administrative Procedure 24.01.01.M4.02.
11. **Payments:** Any use of payments to human subjects must follow Texas A&M University Standard Administrative Procedure 21.01.99.M0.03.

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B. IRB Outcome Letter-3/16/2015

DIVISION OF RESEARCH

Research Compliance and Biosafety

TEXAS A&M UNIVERSITY

DATE: 03/16/2015

MEMORANDUM

TO: Chanam Lee
TAMU - College Of Architecture - Landscape Architecture & Urban Planning

FROM: Human Subjects Protection Program
Institutional Review Board

SUBJECT: Amendment

Protocol Number:	IRB2014-0294M
Title:	The Universal Value of Universally Accessible Play Environments: A Pilot Study
Review Type:	Process Administratively
Documents Reviewed and Approved:	Only IRB-stamped approved versions of study materials (e.g., consent forms, recruitment materials, and questionnaires) can be distributed to human participants. Please log into iRIS to download your stamped approved version of all study materials. If you are unable to locate the stamped version in iRIS, please contact the office.

Description of Submission: IRB Amendment

Comments: Addition of Lu approved.

This research project has been approved. As principal investigator, you assume the following responsibilities:

1. **Continuing Review:** The protocol must be renewed by the expiration date in order to continue with the research project. A Continuing Review application along with required documents must be submitted by the continuing review deadline. Failure to do so may result in processing delays, study termination, and/or loss of funding.
2. **Completion Report:** Upon completion of the research project (including data analysis and final written papers), a Completion Report must be submitted to the IRB.
3. **Unanticipated Problems and Adverse Events:** Unanticipated problems and adverse events must be reported to the IRB immediately.
4. **Reports of Potential Non-compliance:** Potential non-compliance, including deviations from protocol and violations, must be reported to the IRB office immediately.
5. **Amendments:** Changes to the protocol must be requested by submitting an Amendment to the IRB for review. The Amendment must be approved by the IRB before being implemented.
6. **Consent Forms:** When using a consent form or information sheet, you must use the IRB stamped approved version. Please log into iRIS to download your stamped approved version of the consenting instruments. If you are unable to locate the stamped version in iRIS, please contact the office.
7. **Audit:** Your protocol may be subject to audit by the Human Subjects Post Approval Monitor. During the

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life of the study please review and document study progress using the PI self-assessment found on the RCB website as a method of preparation for the potential audit. Investigators are responsible for maintaining complete and accurate study records and making them available for inspection. Investigators are encouraged to request a pre-initiation site visit with the Post Approval Monitor. These visits are designed to help ensure that all necessary documents are approved and in order prior to initiating the study and to help investigators maintain compliance.

8. **Study Materials**: All approved study materials (i.e. consent forms, recruitment materials, and questionnaires) will be stamped electronically by HSPP staff and available for download from iRIS. The IRB-stamped approved versions of these documents MUST be used. For materials that are distributed to potential participants electronically and for which you can only feasibly use the approved text rather than the stamped document, the study's IRB Protocol number, approval date, and expiration date must be included in the following format: TAMU IRB#20XX-XXXX Approved: XX/XX/XXXX Expiration Date: XX/XX/XXXX.
9. **FERPA and PPRA:** Investigators conducting research with students must have appropriate approvals from the FERPA administrator at the institution where the research will be conducted in accordance with the Family Education Rights and Privacy Act (FERPA). The Protection of Pupil Rights Amendment (PPRA) protects the rights of parents in students ensuring that written parental consent is required for participation in surveys, analysis, or evaluation that ask questions falling into categories of protected information.
10. **Food:** Any use of food in the conduct of human subjects research must follow Texas A&M University Standard Administrative Procedure 24.01.01.M4.02.
11. **Payments:** Any use of payments to human subjects must follow Texas A&M University Standard Administrative Procedure 21.01.99.M0.03.

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C. IRB Outcome Letter-6/1/2015

DIVISION OF RESEARCH

Research Compliance and Biosafety

TEXAS A&M UNIVERSITY

DATE: June 01, 2015

MEMORANDUM

TO: Chanam Lee
TAMU - College Of Architecture - Landscape Architecture & Urban Planning

FROM: Dr. James Fluckey
Chair
TAMU IRB

SUBJECT: Exempt Approval

Study Number: IRB2014-0294M

Title: The Universal Value of Universally Accessible Play Environments: A Pilot Study

Approval Date: 06/02/2014

Continuing Review Due: 05/01/2019

Expiration Date: 06/01/2019

Comments: On Wednesday, May 6, 2015, the TAMU Institutional Review Board voted to change studies determined to be exempt to expire in 5 years, rather than 3 years. Once an exempt study reaches the end of the 5-year expiration, an exempt continuation form will need to be submitted to continue the study for another 5 years.

This research project has been approved. As principal investigator, you assume the following responsibilities:

1. **Continuing Review:** The protocol must be renewed by the expiration date in order to continue with the research project. A Continuing Review application along with required documents must be submitted by the continuing review deadline. Failure to do so may result in processing delays, study termination, and/or loss of funding.
2. **Completion Report:** Upon completion of the research project (including data analysis and final written papers), a Completion Report must be submitted to the IRB.
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2. **Food:** Any use of food in the conduct of human subjects research must follow Texas A&M University Standard Administrative Procedure 24.01.01.M4.02.
3. **Payments:** Any use of payments to human subjects must follow Texas A&M University Standard Administrative Procedure 21.01.99.M0.03.

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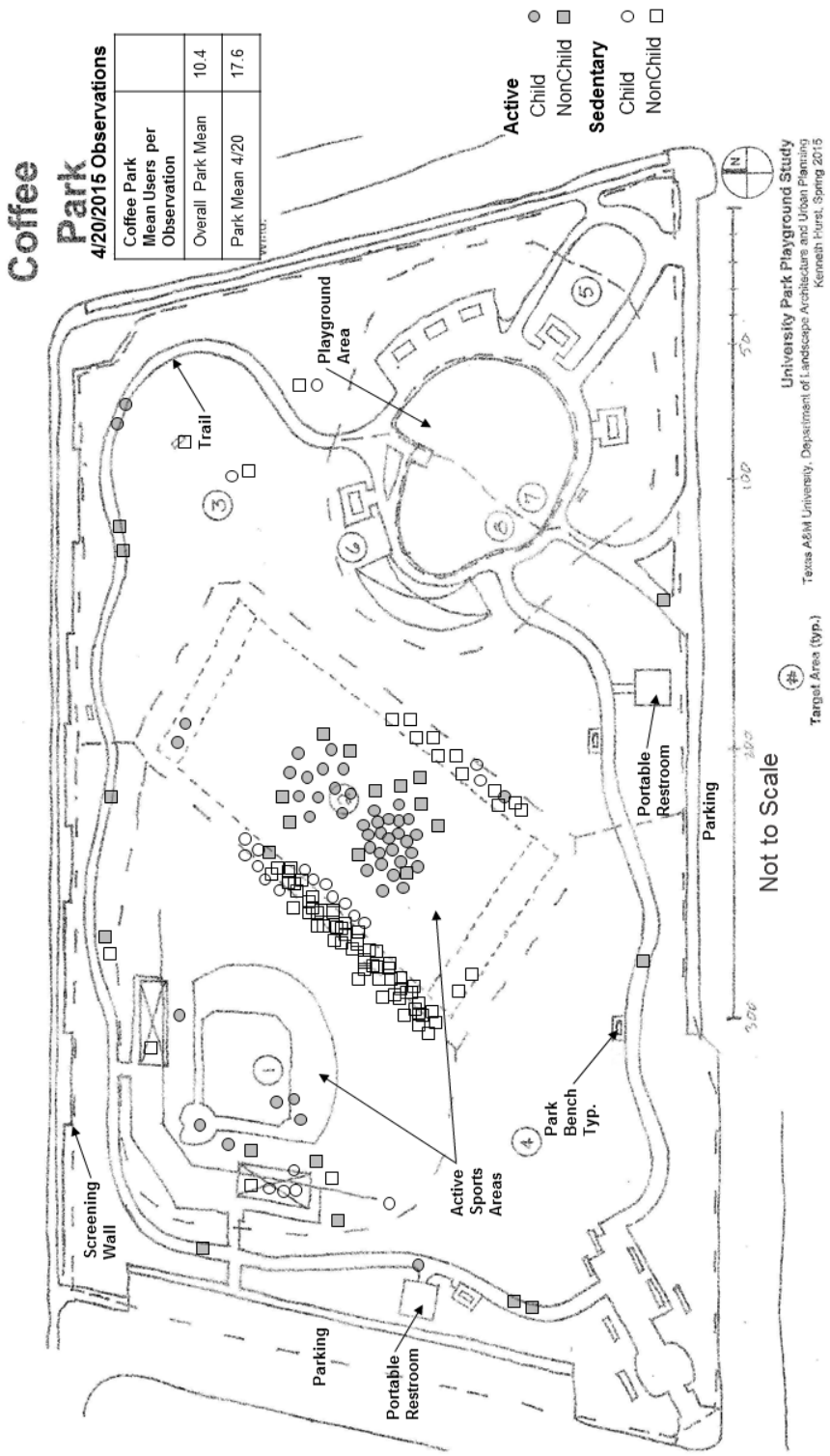
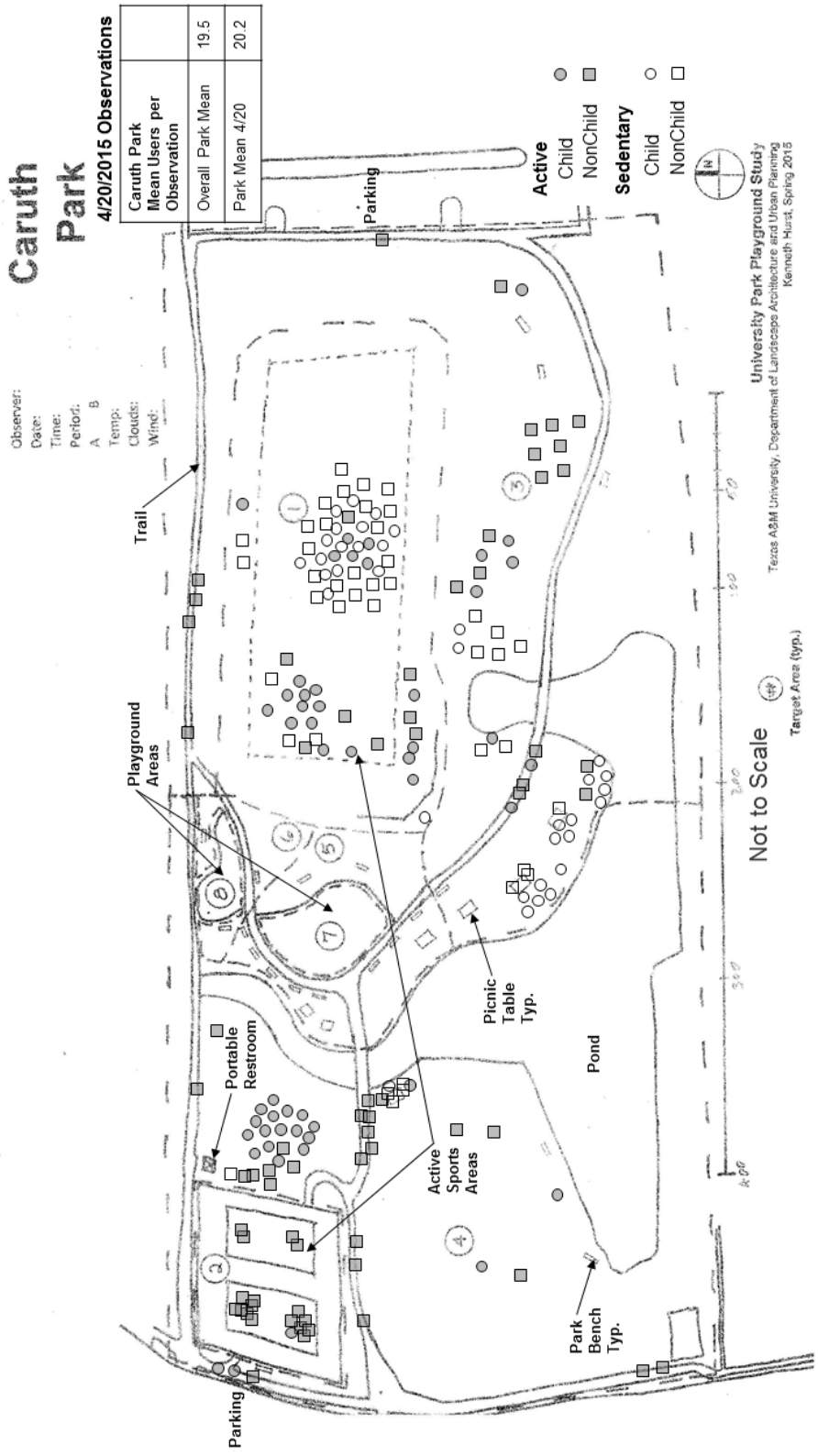
APPENDIX FIVE: BEHAVIOR MAPS

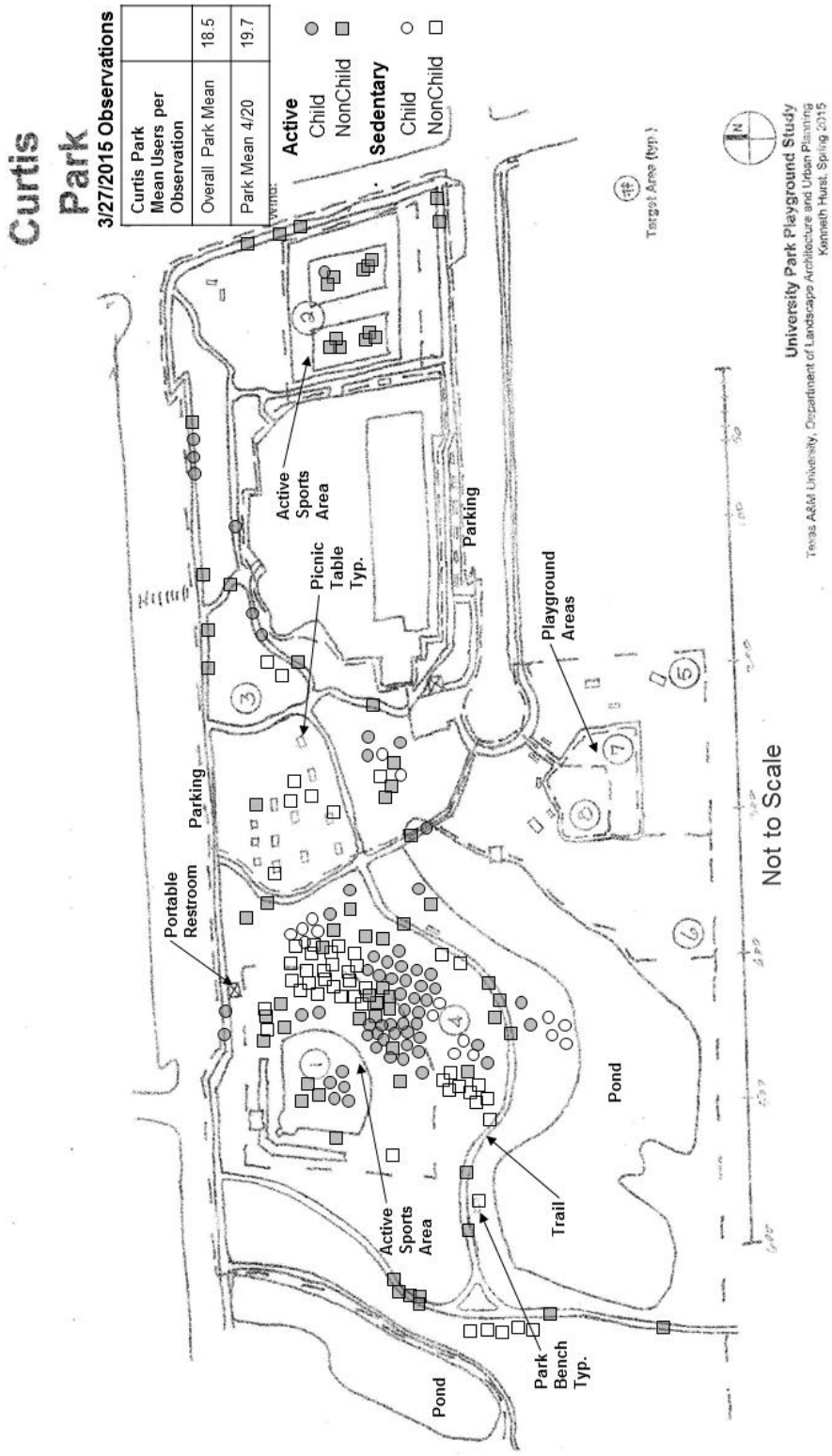
5.1a Coffee Park, Park Zones



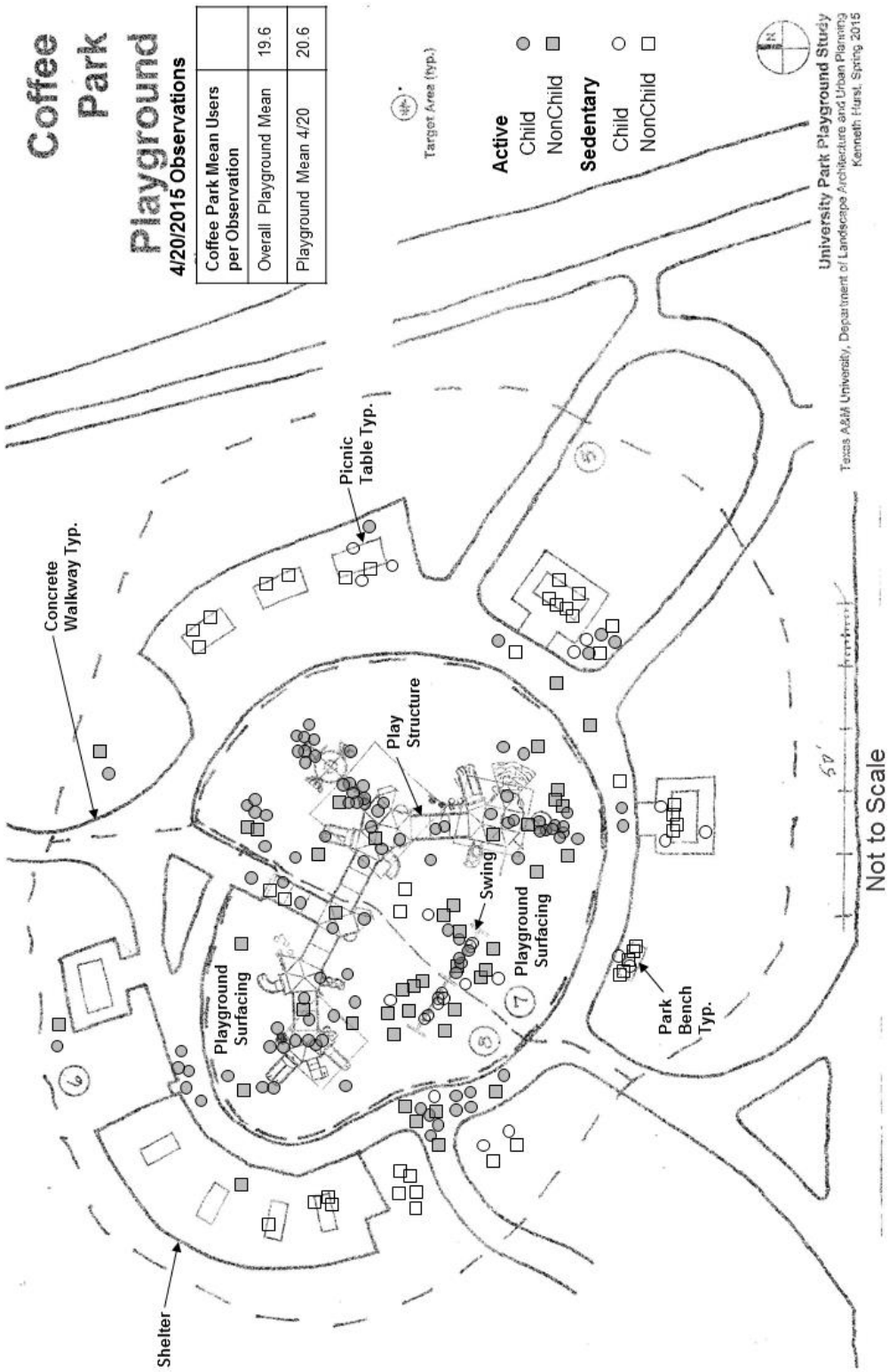
5.2a Caruth Park, Park Zones



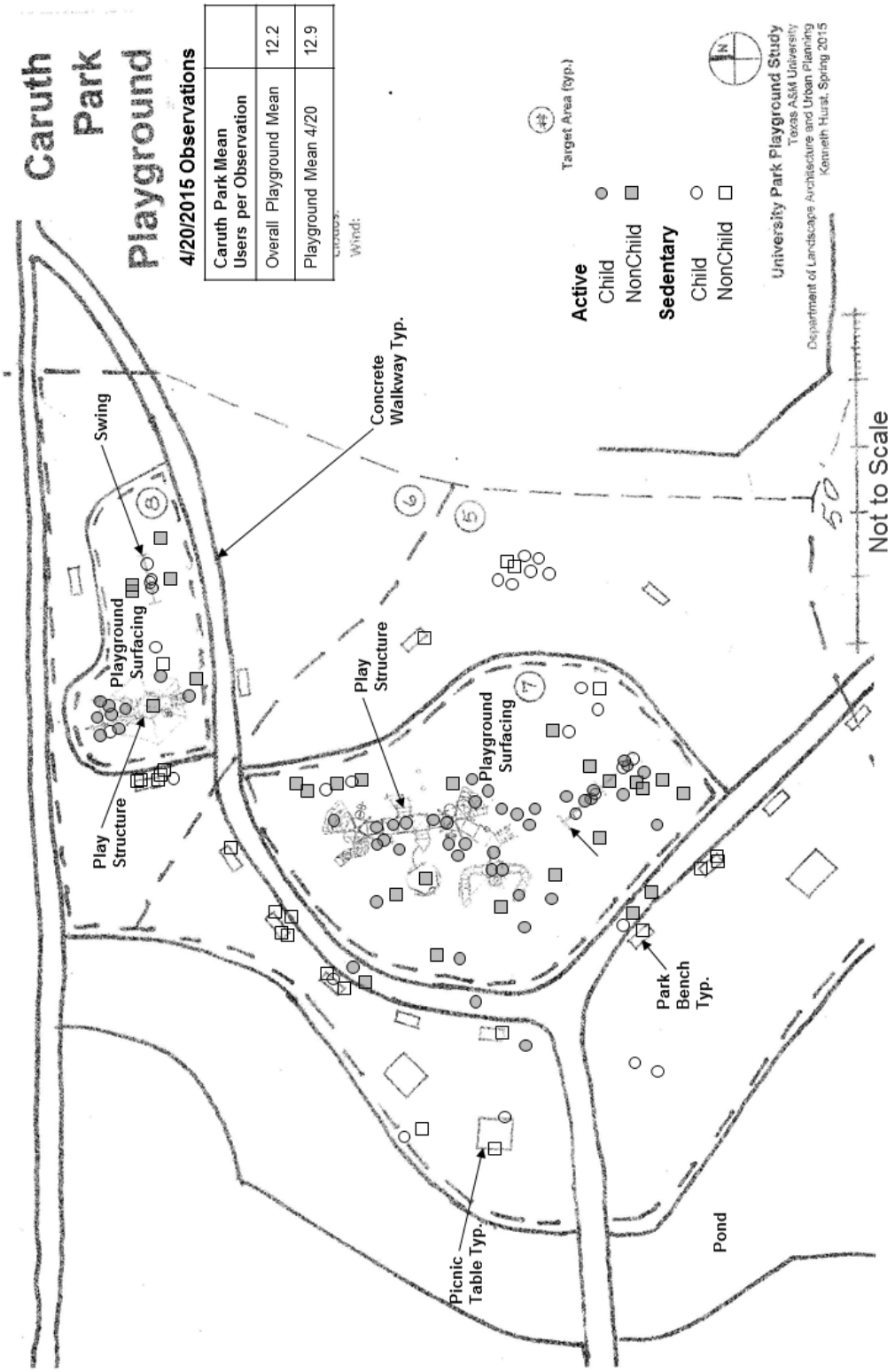
5.3a Curtis Park, Park Zones



5.4a Coffee Park, Playground Zones



5.5a Caruth Park, Playground Zones



5.6a Curtis Park, Playground Zones