

Abstract

THORLEIFSDOTTIR, KRISTIN. Neighborhood Design: Associations between Suburban Neighborhood Morphology and Children's Outdoor, Out-of-school, Physical Activities. (Under the direction of Robin C. Moore and Rune J. Simeonsson.)

The purpose of this research was to acquire a better understanding of environmental mechanisms associated with the development of sedentary behavior by examining the relationship between suburban neighborhood morphology and children's outdoor, out-of-school, physical activities.

Recent research has documented growing concerns about the rise in health problems among children. These concerns are focusing attention on the impact of sedentary lifestyles and the related effects of community design on children's health. Further research is needed on the environmental factors associated with the reduction of physical activity among children.

This study examined neighborhood morphology in relation to school-aged children's outdoor, out-of-school, physical activities, the physical settings they seek, their mobility within the community, and their favorite places. A quantitative-qualitative, multiple case study approach was used in the study of "mixed-use", "traditional", and "co-housing" suburban neighborhoods. Triangulation of data was achieved through the use of a standardized parental questionnaire (n=58), a nine-day children's activity log (n=48), and child-led fieldtrips (n=17). Data analysis took the form of an inductive open-coding process of qualitative data and descriptive statistics of quantifiable data.

The results demonstrated that the frequency and variety of children's physical activities, the variety of settings they used, the distances they traveled, and their favorite places differed by neighborhood. Values were relatively higher in the mixed-use category, lower in the traditional, and intermediate in the co-housing. A consistent gender difference was identified throughout the findings. The study also underlines the importance of neighborhood geographical size, proximity of play and recreational areas, and the inclusion of nature settings in the establishment of activity-encouraging neighborhoods.

The results point to a positive relationship between a diversity of developmentally appropriate neighborhood settings and children's engagement in physical activity. Further, the study offers information on the role of neighborhood design as a catalyst for children's outdoor physical activities with implications for how the design process can contribute to health-promoting outdoor pursuits and make a significant difference in children's lives.

Neighborhood Design: Associations between Suburban Neighborhood Morphology and Children's
Outdoor, Out-of-school, Physical Activities

by
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Dedication

This doctoral dissertation is dedicated to my father Dr. Thorleifur Einarsson, professor of Geology at the University of Iceland, who passed away very suddenly in the spring of 1999. He was the most influential person I have ever known and his spirit and strong presence lives on with his descendants.

Biography

Kristin Thorleifsdottir (Kristín Þorleifsdóttir) was born on October 9th, 1964 in Reykjavik, Iceland. She received her Bachelor of Fine Arts degree from Auburn University at Montgomery in 1996 and a Master of Landscape Architecture from North Carolina State University in 1999. She has been a Ph.D. student in the Community and Environmental Design Program at North Carolina State University since 1999 and a Ph.D. candidate since 2002. She is a member of the landscape architecture honor society of Sigma Lambda Alpha and a recipient of the 2002-2003 American Association of University Women (AAUW) Educational Foundation's International research fellowship. She has also won a number of student awards for her sculptures. While on a leave of absence from North Carolina State University, she returned to her home country Iceland in 2002 to complete her doctoral dissertation while working as a landscape architect, independent researcher, and giving lectures at local universities.

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Working on this Ph.D. has taken more than eight years. It has been a rollercoaster-like process passing through convex and concave emotional landscapes. It has not been an easy experience and I have often asked myself why on earth I decided to pursue it in the first place. Now that I have completed the task it is clear that the reason, first and foremost, has been a keen and enduring interest in the topic itself, coupled with a firm desire to use my findings as a catalyst for real and positive changes within this sphere of environmental design.

I could never have taken on this challenge without the support of my family and many friends, to whom I am very grateful. Above all, the support and understanding of my husband Ólafur Ólafsson and my two children, Diljá and Thorleifur, has been much more than anyone could ever have wished for. On coming to NC State to pursue a degree in landscape architecture in 1996 my son Thorleifur was a toddler and my daughter Diljá was in first grade. Now, as this Ph.D. degree comes to completion, they are fifteen and eighteen years old. This work has affected their lives as it has mine and I am indebted to them for their unfailing support, love and understanding.

Special thanks are due to my primary advisors Robin Moore, professor of Landscape Architecture and NCSU, and Dr. Rune Simeonsson, developmental psychologist and professor of Education at UNC, for their invaluable influence, wise counseling, support and tireless reviewing. I would also like to thank my other committee members Art Rice, professor of Landscape Architecture at NCSU, Dr. Penny Gordon-Larsen, professor of Public Health at UNC, Dr. Wayne Place, professor of Architecture at NCSU and Dr. Faith Rifki, former committee member and professor of Architecture at NCSU, for their support, encouragement and feedback, and Dr. Terry Hartig, professor in Applied Psychology at the Institute for Housing and Urban Research in Sweden, for reviewing a draft research paper on the topic. Thanks are also due to Scott Simmons, Chapel Hill Planning Department and Amanda Clarke Henley, Geographic Information Systems Librarian, UNC University Libraries for assisting me with GIS and Census data for the neighborhoods.

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All photographs used in this document were taken by the author.

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1 The Problem and Its Setting

1.1 Children's Health is at Risk

A growing body of research has documented that alarming and increasing numbers of children now suffer from “lifestyle” related health problems such as overweight and obesity (Centers for Disease Control and Prevention, 2001c; Cowley & Begley, 2000; Dishman & Sallis, 1994; Penny Gordon-Larsen, McMurray, & Popkin, 2000; J.F. Sallis, McKenzie, Elder, Broyles, & Nader, 1997; Shochat et al., 2001; Troiano, Flegal, Kuczmarski, Campbell, & Johnson, 1995; Zill & Shoenborn, 1990). According to two NHANES surveys (1976–1980 and 2003–2004), 19 percent of children ages 6-11, and 17 percent of children ages 12-14 are overweight. These numbers have quadrupled since 1970, when the numbers were no higher than five percent in any of the age groups (Centers for Disease Control and Prevention, 2004; Ogden et al., 2006; Ogden, Flegal, Carroll, & Johnson, 2002), and nearly one-third of children aged six to nineteen, of both sexes, is considered to be either at risk of being overweight or is overweight (Hedley et al., 2004).

Overweight and obesity are major risk factors for chronic diseases, including type 2 diabetes, cardiovascular disease and some cancers (Daniels, Arnett, & Eckel, 2005; Department of Health and Human Services and US Department of Agriculture, 2005; Institute of Medicine, 2005) which are three of the leading causes of death in the United States (U.S. Department of Health and Human Services, 2001). Obese children are also often stigmatized and discriminated against (Schwartz & Puhl, 2003) and the probability of childhood overweight, persisting into adulthood, increases from approximately 20 percent at four years of age, to between 40 percent and 80 percent by adolescence (Guo & Chumlea, 1999).

The rapid increase in overweight among children is generating widespread concern. Many investigators have attempted to explain the obesity epidemic, but no single theory has sufficiently explained all of the contributing factors (Booth, Pinkston, & Poston, 2005). Research, seeking empirical explanations to these rising problems, has identified three main influential factors for the rise childhood obesity: excessive food intake and increased consumption of high fat fast food and snacks; increasing inactivity; and decrease in physical activity (Cowley & Begley, 2000; Department

of Health and Human Services & Department of Education, 2000; Goran, Reynolds, & Lindquist, 1999; Gortmaker, Sobal, Peterson, Colditz, & Dietz, 1996; Hill & Peters, 1998; Troiano et al., 1995). One of the indicators identified as influential on physical activity, diet, and obesity is neighborhood design (Ewing, Schmid, Killingsworth, Zlot, & Raudenbush, 2003).

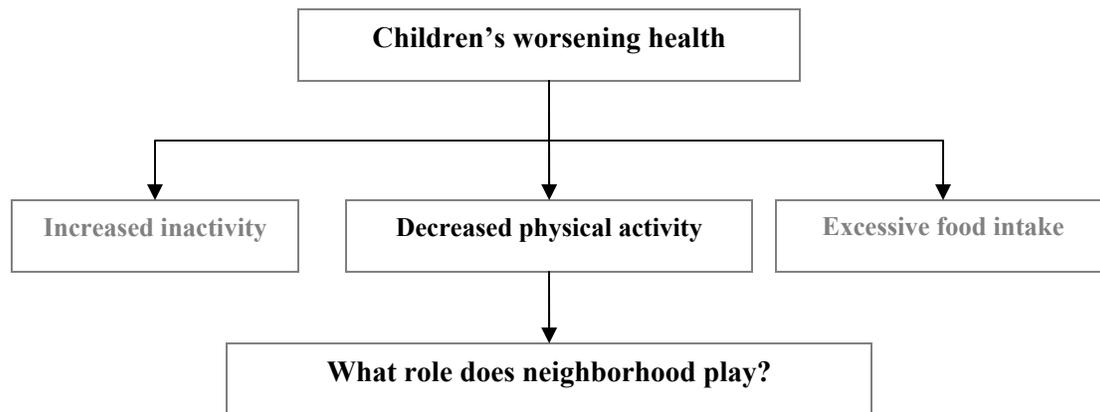


Figure 1: An overview of the problem and its setting

Indicators that have been identified for decreased physical activity are for example daily recess removed from many school schedules (Centers for Disease Control and Prevention, 2001a; Penny Gordon-Larsen et al., 2000), decreased time for free play (Pasquali & Hernandez, 1997), increased indoor inactivity such television watching and computer use (Woodard & Gridina, 2000), and extended school programs and increased attendance in supervised after-school activities (Rosenbaum, 1993). Increased concerns for children's academic achievement have also contributed to restrictions on play within their neighborhood environments (Davies, 1996). Children's lives have thus become increasingly structured and scheduled by adults.

Due to its broad health impact, physical activity has been included as one of the ten leading health indicators for the nation (U.S. Department of Health and Human Services, 2000). Children's outdoor physical activities are an important component in the development of cognitive, social, affective, and physical competences and there is consensus that physical activity is an important determinant of health status, including cardiovascular functioning, skeletal integrity, and psychological wellbeing (Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997; J.F. Sallis, 1994).

According to a Panel Study of Time Use in American Households 1982 (Collins, 1984), approximately 60 percent of school-aged children's time during the week is spent in activities that,

for the most part, they must do such as eating, sleeping, attending school, washing and dressing, and doing homework. When these hours are counted for the average child has approximately 67 hours a week of free time. Two types of activities dominate the out-of-school discretionary time: television viewing and time “on their own” including play with peers and other activities without adult supervision or involvement. Another study of time use estimates that these two activities consume about 70 percent or more of children’s roughly 7 hours of out-of-school free time (Medrich, Roizen, Rubin, & Buckley, 1982). These two studies are however more than 20 years old during which the lifestyles have changed.

Despite the importance of establishing a physically active lifestyle early in life, studies have showed that children’s levels of activities, fitness, and health dropped by 25 percent between 1981 and 1997, or almost four hours per week, from 15 hours a week to 11 hours and 10 minutes (Centers for Disease Control and Prevention, 1997). During the same period, the time they spent in school increased by almost five hours (Hofferth & Sandberg, 2000). Results from a CDC national study of children aged nine to thirteen indicated that 62 percent do not participate in any organized physical activity during their non-school hours and that 23 percent do not engage in any free-time physical activity (Centers for Disease Control and Prevention, 2003).

There are also indications of a dramatic decrease in walking among children. According to the Mean Streets report, children’s walking dropped by 37 percent in the last 20 years and almost 70 percent of children’s trips take place in the back-seat of a car (Surface Transportation Policy Partnership, 2000). In the United States, nearly 25 percent of all trips are less than one mile, but more than 75 percent of these short trips are made by automobile, so it is reasonable to expect that many trips could, in fact, be made on foot or bicycle (Killingsworth & Schmid, 2001).

With this knowledge in hand, public health officials and community designers are increasingly focusing their attention on the impact that the quality of the physical environment may have on children’s health, particularly increases in overweight and obesity. Sallis (1997, also citing Dishman & Sallis 1994) states that the physical environment is the least studied potential determinant of physical activity, and that it is important to understand its likely effects, as environmental characteristics may influence large populations. It seems obvious that the physical environment is a major determinant on children’s physical activities. The identification of environmental determinants that promote and stimulate children’s physical activities must therefore be taken into account when designing urban environments.

1.2 Non-supportive Physical Environments

It is only recently that public health officials (Egger & Swinburn, 1997; Hill & Peters, 1998; J.F. Sallis, Prochaska, & Taylor, 2000), have turned their attention to the full impact of environmental and contextual determinants on physical activity, and have seriously started to question the integrity of sprawling suburban development, and the increasing impact it has on the environment and human wellbeing. The increased recognition of children's physical activities as important health determinants has resulted in increased attention to neighborhood physical qualities (Lennard & Crowhurst Lennard, 1992; Medrich et al., 1982; Moore, 1986; Susa & Benedict, 1994, citing Hart & Sheehan, 1986).

Despite the growing interest in promoting interventions that encourage physical activity, limited evidence is available to indicate which specific environmental factors influence physical activity (Humpel, Owen, & Leslie, 2002). At the same time that many major public health reports advocate for environmental interventions, as part of a comprehensive awakening to promote physical activity (Department of Health and Human Services & Department of Education, 2000; Frumkin, Frank, & Jackson, 2004), the contemporary design and planning literature advances assertions and general statements regarding poor regional planning and inadequate neighborhood design, and how these have contributed to the increase in serious health problems (Burden, Wallwork, Sides, Trias, & Bright Rue, 1999; Girling & Helphand, 1994).

Urbanization in the USA has changed dramatically since the end of World War II. Following a tremendous increase in automobile ownership, massive construction of highways, and unplanned growth processes, long distance commuting became a feasible option to a growing middle class (Broadbent, 1990; Krier, 1998). Continuous suburban growth and restricted zoning (the division of land into separate zones, each with a particular and similar use or function, such as industrial, commercial, institutional, residential etc.) has led to isolated, monotonous, and automobile-oriented rearing environments with limited functional and experiential options for children e.g., (Broadbent, 1990; Crain, 2000; Francis, 1987; Frumkin et al., 2004; Jackson, 1985; A. Jacobs & Appleyard, 1987; J. Jacobs, 1992; Krier, 1998; Kunstler, 1993; Southworth & Parthasarathy, 1996; Southworth & Parthasarathy, 1997).

Cities in general are not planned and managed with children in mind. Decades ago, children used to walk and ride bikes everywhere, to school, friends' houses, the park or store, and parents did not have to fear for their safety. Today, children are not as free to walk and play outdoors because many communities have been designed to be convenient for cars, not for children e.g., (Centers for

Disease Control and Prevention, 2001b; Surface Transportation Policy Partnership, 2000, 2004). Public activity centers that are important to children, including schools, parks and recreational sites, can usually only be reached by automobile, making children entirely dependent upon adult chauffeuring (Girling & Helphand, 1994; Kunstler, 1993; Southworth & Parthasarathy, 1997). This has clear implications for the safety of children and for their ability to use the streets on their own terms (L. Frank, 2000; Heurlin-Norinder, 1997; Rosenbaum, 1993; Surface Transportation Policy Partnership, 2004). Although the burden of medical costs associated with physical inactivity is high (estimated at about \$76 billion per year) and that 11 percent of all traffic deaths are pedestrians (13 percent if bicyclists are included), the federal transportation program spends less than one percent of its budget on creating safer places to walk and bicycle (Surface Transportation Policy Partnership, 2004).

A few (mostly qualitative) studies on children's neighborhood environments have been reported since the 1970s and 1980s with the work of Ward (1978), Moore & Young (1978), Hart (1979), Björklid (1979), Berg & Medrich (1980), and Moore (1986). These early studies addressing children's neighborhood perceptions, preferences for types of places, and territoriality provide a valuable backdrop to understanding children's activities in residential neighborhoods. However, children's lifestyles and activity patterns, and consequently wellbeing, have greatly changed in recent decades requiring new research.

Although present day equivalent studies of children and neighborhood design have yet to be conducted, it seems clear that that inappropriate community planning, in combination with other contemporary lifestyle factors, has seriously contributed to children's decreasing physical activity, fitness, and health. Most obvious is that territorial range of public outdoor settings have become severely restricted (Southworth & Parthasarathy, 1996).

For some children their neighborhood, apartment complex, or house has no adequate outdoor play spaces and limited access, if any, to informal public open spaces (A. F. Taylor, Wiley, Kuo, & C., 1998) such as open fields, woods, left over spaces, hills, ponds, and wetlands, or other valuable spaces containing interesting vegetation, rock outcrops, and wildlife (Louv, 1990). As stated by Early (2007), the major problems related to the provision of outdoor playing spaces include: "the continuing loss of outdoor recreational facilities; outdoor facilities frequently being replaced by indoor provision, which is more expensive to provide and maintain; facilities for children being provided at a cost and under lock and key as opposed to open-access provisions; and the location of equipped play facilities in central locations at the expense of very local provisions, sometimes accompanied by the removal of facilities (The National Health Forum, Living Streets, & CABE, 2007)." The lack of consideration of

semi-private spaces along residential streets such as front yards, forecourts, porches, and places to sit is also of concern (Gehl, 1986, 2001). In a time of fast urban development and infill projects, there is thus a need to safeguard open space for children's outdoor activities.

Linear settings are another design attribute that has largely been ignored. Intra-neighborhood mobility is often a disregarded concept due to the subdividing of land into privately owned lots. Most traditional suburban neighborhoods lack paths and other pedestrian connections such as sidewalks, greenways, bike paths, or under/over passes. No public settings are left to design or allow for the creation of informal paths such as nature trails, dirt-bike trails, trails for horse-riding, cut-across paths, in-between paths, access pathways to isolated cul-de-sacs, etc. This evolution has had a significant effect on children's mobility and outdoor activities e.g., (Surface Transportation Policy Partnership, 2004).

One of the greatest changes in urban structure affecting children's quality of life is pedestrian accessibility of school (Centers for Disease Control and Prevention, 2001a). During the early decades of the last century, schools were located in densely built residential neighborhoods but according to a survey of about 200 school sites in South Carolina, most schools built since 1980 are located in remote locations discouraging children from walking to school (Kouri, 1999). Only four percent of children attending schools built after 1983 walk to school, while 16 percent walk to those built before 1983. Even children who live within 1.5 miles of recently built schools frequently need bus transportation, because of the hazards of busy highways and absence of sidewalks (Kouri, 1999).

A CDC report (2001) also addresses the issue of school accessibility and connectivity, stating that 41 percent of students walked or biked to school in 1969, but by 2001 the proportion had dropped to 13 percent. According to the report, only 31 percent of children who live within one mile from school, walk or cycle to school, and only two percent of those who live within two miles. It is also stated that half of the decline may be related to the fact that the distance to school has increased over time, and that distance is in fact the strongest contributor on the decision to walk or bike (Centers for Disease Control and Prevention, 2001b; McDonald, 2007). A more recent study by Martin (2007) presented similar findings – even though a third of American children live within a mile of their school barely half of them regularly walk or bike to school. The study also found that children aged 11 to 13 were more likely to walk or bike to school than nine-year-olds. The findings were particularly true for children who live in the South, in rural areas, or who have college-educated parents, which is interesting because lack of exercise and higher rates of obesity have been correlated with less educated families (Martin, 2007).

Over the past decades urban development has had an increased negative impact on children's outdoor activities by reducing restricting their home range, in terms of both social and physical terrain - a phenomenon referred to as the "childhood of imprisonment" by Mark Francis (1990). Whereas parental supervision might be considered appropriate, parents' anxiety over their children's safety has further added to restrictions on children's outdoor activities within the neighborhood (Davies, 1996; Francis, 1987; Wardle, 1990; Whyte, 1980). Children's lives have become more structured, confined, and overly supervised, and their physical boundaries have "shrunk" (Devereaux, 1991). This has resulted in restricted freedom to experience and learn through outdoor activities free from adult supervision, and decreased children's opportunities to enjoy and explore their surroundings (Rosenbaum, 1993).

Although spaces for children's play and recreation have largely been ignored by community planners and that the literature on child development rarely mentions the value of the outdoor environment in healthy development, an understanding of the significance of such spaces for healthy child development is vital in future urban development and community wellbeing.

1.3 Need for Research

It is widely confirmed that children's health is worsening at an alarming rate and that sedentary lifestyles greatly affect their wellbeing. In the search for explanations, researchers have increasingly been turning their attention to the quality of the physical environment and urban development at various levels, ranging from comprehensive regional planning to the design of building interiors.

Many academics and professionals in public health and design and planning fields state that in order to develop activity-promoting design strategies, the ways children use the residential landscape needs to be better understood. There is a consensus that children's outdoor physical activities are an important component of child development and health, and although children are in general very resilient, it is essential to provide activity-promoting neighborhood environments. Indeed, it has been stated that the nature and extent of children's outdoor physical activities depends heavily upon the potential of the physical environment to meet children's developmental needs (R.G. Barker & Wright, 1955; J.L. Frost, Shin, & Jacobs, 1998).

Despite growing concerns that contemporary neighborhoods do not fulfill children's needs for physical activity, they are rarely mentioned in discussions of new neighborhood models e.g.,

(Girling & Helphand, 1994; Southworth & Parthasarathy, 1997). Recent studies have examined children's physical activity in relation to specific environmental features for review see e.g., (Alfonzo, 2005; Booth et al., 2005; Humpel et al., 2002; Saelens, Sallis, & Frank, 2003; Wells, Ashdown, Davies, Cowett, & Yang, 2007) but none have focused on the relationship between types of physical activities and neighborhood morphology at large including types of destinations and linear settings that connect them.



2 Review of Relevant Literature

What role does the physical environment in neighborhoods play in children's lives and what are the relationships of the physical environment and children's outdoor physical activities? The goal of the literature review is to build a conceptual framework around this central question, divided into three main sections: (i) a review of fundamental theories in the field of Environment and Behavior (E&B), (ii) a review of children's developmental needs in terms of outdoor physical activities, and (iii) research literature on environmental determinants for physical activities.



2.1 Children's Environments: Supporting Theories

2.1.1 The Constructionist Perspective

This research is consistent with the Constructionist epistemological view where the *interaction* between the object and the subject is the reality - the partnership with no one true or valid interpretation. This epistemological view establishes research as dependent on human value systems; the research design, the selection of variables, samples, methods and the interpretation of the data are controlled by the researcher, and the subject matter can not be removed from the setting. According to this perspective, no research subject can stand in a social and/or physical vacuum. Only by considering the related interactions can a holistic understanding be achieved (Crotty, 1998).

2.1.2 Environment and Behavior Theories

Prior to Environment and Behavior Science (EBS) it was common (in the field of psychology) to consider development in terms of physical growth, social influence, and social environment, while the physical environment was rarely included as being a complex influential phenomenon (Prohansky, Ittelson, & Rivlin, 1976). Since the late 1960's the study of behavior in relation to the socio-physical environment has been one of the most rapidly developing areas of psychological research (ecological psychology and environmental psychology). This approach is uniquely concerned with the ways in which individuals and groups carry out transactions with the environment and focuses on the interaction between the developing active individual and the active evolving environment. It represents a view of human development in which the individual and the environment are considered as active components in an ongoing reciprocal interactional process. It is defined as the action occurring between various elements, specifically between various parts or subsystems of the organism, or between the organism, its subsystem, and the environment (Björklid, 1982).

From the above it can be determined that the organism is inherently and spontaneously active and an external condition can never in itself be the sole determinant of an effect. Rather, cause and effect stand in a relationship of reciprocal action, affecting and changing each other. Hence, there is a reciprocal bi-directional causation, or interaction, which accounts, in part, for the organismic rejection of mechanistic analytic procedures, which maintain that a complete efficient causality is possible (Björklid, 1982). According to this model, a person adjusts to a specific context depends on the individual characteristics, the environmental attributes, and their interaction (Moore, 1986). In their discussion of research with children, Graue & Walsh (1998) emphasize that people are social in nature and when doing research with children, they should be considered as social actors. According to them, "the goal should not be to look within the child but between children at their interactions and relationships that make up their lives (Graue & Walsh, 1998)."

It is from the interaction ideology that EBS (Environment & Behavior Science) is founded. The interactional view emphasizes the interplay between individual factors and environmental factors as a mean to study behavior based on how the individual both influences and is in turn influenced by the environment. "[S]ituations are as much a function of the person as the person's behavior is a function of the situation (Björklid, 1982)." People and their behaviors are a part of a whole system and cannot be empirically separated. Human behaviors always happen in a place (behavioral setting) and cannot be fully evaluated without considering environmental influences (Duerk, 1993). Likewise, place cannot and should not be evaluated as separate from human behavior. One cannot make an assessment of a place without understanding the goals, users' needs and wants, and the activities that

the place supports. This way of understanding how humans interact with nature provides the theoretical parameters for this study; the physical environment affects people's behavior (children's physical activities) and people affect the environment— even as a result of simply being there.

Although the origins of Environmental Psychology can probably be traced to the pioneer work of Kurt Lewin (1890-1947), who developed the 'Field Theory' as an attempt to represent the person and the environment in the graphic terms of topology, and Egon Brunswik (1903-1955), who was a pioneer of cognitive psychology, most lean more towards the work of James J. Gibson, Roger Barker, or Urie Bronfenbrenner (Heft, 2001). The three fundamental theories brought together form the framework this study rests on.

2.1.3 Gibson's Affordance Theory

James J. Gibson's (1904-1979) view is that of ecological perceptual psychology. Gibson (1979) stresses the mutuality of the animal (person) and the environment. He emphasizes that people implicate each other and that they do not construct the world that they live in, but are attuned to the invariants of information in the environment. Gibson developed the concept 'affordance' to account for the fact that our perceptual experience includes not only awareness of the structure of objects and events in the environment, but also, and perhaps more fundamentally, and awareness of their functional significance, that is, their functional meaning (Heft, 1988).

Departing from the long-held position in the philosophy and psychology of perception that the meaning of objects and events for a perceiver is imposed on sensory input by cognitive processes, Gibson argued that this meaning is directly perceived; that it is objectively specifiable in the environmental information available to the perceiver. "The environment, for an animal is not the environment of physics, but a layout of surfaces and objects appropriate to the scale of the animal (J. J. Gibson, 1979)." Thus, for the human being, the information to specify the utilities of the environment is accompanied by information to specify the observer himself, his body, legs, hands, and mouth (E. J. Gibson, 2001). The environment is structured but events taking place in the environment may involve change of structure. Thus, an animal is a perceiver of the environment and behaves in it in accordance with what the environment affords it and reciprocally, the animal's behavior changes the environment (E. J. Gibson, 2001).

When studying children and the settings they use, the organism and the environment cannot be studied as unrelated entities. After the environment has been described, the properties it offers for related behavior should be identified. The primary question is therefore "Are there any environmental

properties that fit the behavioral capabilities of children?” or simply “What does the environment afford (Heine & Guski, 1998)?”

Gibson offers a broad classification of affordances: terrain features, shelters, water, fire, objects, tools, other animals, and human displays (J. J. Gibson, 1979). Terrain refers to topographical features such as paths, obstacles, barriers and slopes that give the layout of surfaces particular functional possibilities. Topographical or landscape features make certain activities possible while limiting others; this is also true of micro-climatological attributes. Both are malleable in design terms. Also significant are socio-cultural practices as the functional meanings of a place are often established in relation to these practices. Attached place meaning and symbolism may develop with time into sacred or otherwise significant places; those places may later be constructed for specific functional purposes such as churches, mosques and the like (Heft, 2001).

2.1.4 Heft’s Functional Approach to Environmental Description

Building on Gibson’s theory, Heft (1988) conducted a meta-analysis of several observational studies on children’s outdoor activities and formed taxonomy of affordances or categories of children’s environments. As an example, an object that is smaller than the hand-span of a particular individual is perceived by that person to be graspable, that is, it affords grasping (Heft, 1988, citing Hallford, 1984) and a horizontal surface that is positioned within a specific height from the ground relative to the leg length of a particular individual is perceived by that person to be climb-on-able (Heft, 1988, citing Warren, 1984). Thus, environmental features can be described in this functional manner by referring to what activities they permit or afford the individual such as graspable, climb-on-able, lift-able, walk-on-able, hide-behind-able, etc. (Heft, 1988).

A distinctive characteristic of these affordances therefore is that they are relatively stated. Affordance properties are determined both by attributes of the environmental feature in question and those of the individual user. Consequently, when we wish to assess the functional possibilities or affordance of a particular place, we must have some individual, or type of individual, in mind (Heft, 1988).

According to Heft there are two approaches in describing the environment; *form-based* and *functional-based*. The former concentrates on the formal values of objects, and is the most widely adopted method of describing the environment - though form-based distinctions may be comparatively abstract ways of experiencing it. Where formally-derived values are used the properties of environmental features are considered independently of the individual. However, the

functional significance of these features depends on their attributes relative to individual use. For instance, whether or not a tree affords climbing depends on attributes of the tree relative to the pertinent attributes of a particular person (e.g., perceived heights of branches in relation to that person's arm- and leg-length).

Functional descriptive categories differ from form categories in that a given environmental features can have multiple affordances whereas form attributes are mutually exclusive. A particular feature can be employed for many purposes, and we delight in discovering new purposes for familiar things. The functional-based approach may be especially useful when studying the relationship between children and the environment; the primacy of affordances in environmental experience may be particularly pronounced in young people, as their experience of environment tends to be less intellectualized than that of adults.

Heft points out that the consideration of affordances has interesting consequences for environment-behavior analysis that is; this kind of functional description of children's environments offers a rich way of conceptualizing the ecological resources for human development.

Heft's idea for a taxonomic list can be organized in various ways (figure/ground or ground/figure) where each one of these activities requires a particular environmental feature to support it taken with reference to this particular individual such as: balance-able, bike-able, hide-behind-able, kick-able, skateboard-able, slide-able, swim-able, swing-able, and walk-on-able. Heft's original taxonomy consisted of 10 functional affordance categories: 1. flat, relatively smooth surfaces, 2. relatively smooth slopes, 3. graspable/detached objects, 4. attached objects, 5. non-rigid attached objects, 6. climbable feature, 7. shelter, 8. moldable material (dirt, sand, snow), 9. water, and 10. aperture (locomotion, looking and listening to an adjacent place). Kytta (2002, citing Greeno, 1994) stresses the importance of noting that affordances can be regarded as a graded property rather than one which belongs to an either/ or category, but describes affordances at different levels, depending on whether they are potential, perceived, utilized, and shaped affordances (Kytta, 2002).

2.1.5 Barker's 'Behavior Settings Theory'

Although the concept of affordance is unique to Gibson's theory, Roger Barker and Henry Wright also emphasize the perceived functional character of environmental features, both with regard to their concept of *psychological habitat* and their analysis of *behavior settings*.

Barker and Wright, often referred to as the founders of Ecological Psychology, were students of Kurt Lewin. Responding to Lewin's psychological ecology concept, they developed his ideas much

further. In 1947, Barker and Wright began a large-scale investigation of life in a small Midwest town. They were particularly interested in small ecological units enclosing everyday human behavior and the behavior of children in ‘natural’ settings (R.G. Barker & Wright, 1955). Among the first data collected were detailed narrative records of the observed activities of individual children over the course of the day, one of them later to be published as a book, *One Boy’s Day* (Roger G. Barker & Wright, 1951).

Barker and Wright (1955) considered behavior to occur within a psychological context, which they call psychological habitat. They specify the *psychological habitat* as being located “at the intersection of the behaving person and the non-psychological milieu” (p.11) and *behavior* as an act that occurs in episodic units, marked by goal-directed activity that has a beginning, directionality, and an end. Barker and Wright were also concerned with identifying the environmental antecedents of the *behavior episodes* (Heft, 2001, p. 251). These functional possibilities in the psychological habitat emerge from the relationship between the subject and the features of the immediate environment.

Like affordances, the functional properties of the psychological habitat are relational in nature, being derived from both the attributes of the person under consideration and attributes of the environment. Out of this relationship, particular psychologically meaningful properties of the environment are realized (Heft, 1988). The Midwest study of children’s’ behavior revealed three behavior patterns (R.G. Barker, 1968):

- “1. The characteristics of the behavior of a child often changed dramatically when he moved from one region to another, e.g., from classroom, to hall, to playground, from drugstore to street, from baseball game to shower room.
2. The behavior of different children within the same region was often more similar than behavior of any one of them in different regions.
3. There was often more congruence between the whole course of a child’s behavior and the particular locale in which it occurred than between parts of his behavior and particular inputs from the locale.”

These patterns of action pointed to higher order ecological units or environmental structure with respect to which behavior of different children was congruent that is, the environment, considered independently of an individual’s experience, is structured and ordered. This structure, Barker calls behavior settings (Heft, 2001). His idea of identifiable higher order environmental structures that influence behavior in predictable ways is different from the views of Brunswik and Lewin: “I found not only that the non-psychological environment affects the life space at the boundary, but also that the distal environment has consequences” (Heft, 2001, citing Barker, 1989).

With his concept of behavior settings, Barker (1968) illustrated that the same people behave very differently in different places and in similar ways in the same place where agreed upon cultural rules, the boundaries, and the artifacts combine to signal appropriate behavior (Duerk, 1993). Behavior settings are small ecological units or sub-systems that enclose everyday human behavior (R.G. Barker, 1968; Gifford, 1997) and describe the interdependencies of activity and physical setting (Duerk, 1993). Bronfenbrenner (1979 & 1987) describes them as a nested collection of settings in which the individual functions (Holady, Swan, & Turner-Henson, 1997). Barker (1968) proposed the following properties for behavior settings:

1. They occur naturally as a function of the collective actions of a group of individuals.
2. They have a specifiable geographical location.
3. They have temporal boundaries that are self-generated and maintained by the dynamics of its occupants. The boundaries are discriminable; they can be perceived.
4. They are quasi-stable; they manifest mechanisms in response to perturbations and in so doing, within limits they preserve their integrity.
5. They exist independently of any single person's experience of them.
6. Individuals who occupy a particular behavior setting are to an appreciable degree interdependent.

Behavior settings consist of on-going patterns of activity (behavior) and the environmental features that support as well as constrain the activity (Heft, 1988). An individual entering a behavior setting will experience "pressures" to act in a manner consistent with the perceived character of the setting (Heft, 1988). As an example of this coercive influence Barker and Wright state that children appear to see a smooth, level area which is free from obstructions...as places for running and romping in unorganized, exuberant activity. The "non-psychological milieu" features of such behavior settings appear via perception to demand this kind of behavior and are loaded with perceived, seductive characteristics (Heft, 1988). Thus, the physiognomy of the milieu, like affordances of a place, establishes the possibilities for activities in a behavior setting.

Behavior-setting theorists tend to explain person-environment relations primarily in terms of the social features of a setting, such as rules, customs, and typical activities, and its physical features (Gifford, 1997). Behavior settings are not static entities; they are born, they struggle, adapt, thrive, and die (Gifford, 1997, citing Allan Wicker).

Although the concepts of affordances and behavior settings grow out of different theoretical frameworks and research programs (Gibson from perceptual psychology and Barker from environmental psychology) both arrived quite independently at essentially the same conclusion;

namely that the functionally significant properties of the environment are perceived qualities that emerge from person-environment relations (Heft, 1988).

Heft (2001) unifies Gibson's concept of affordance and Barker's concept of behavior settings in a way that broadens and focuses both. He states that considering affordances from the perspective of behavior settings leads to the recognition that affordances are often components of a behavior setting. This is valuable because it provides a means of thinking about how some affordances are distributed in the environment. Likewise, it leads to recognizing that learning about affordance can entail both understanding their functional properties and understanding where in the environment they can be found (Heft, 2001).

Both Gibson's theory and Barker's theory and the functional affordance taxonomy developed by Heft (1988) are limited to objects and defined behavior settings, but lack the consideration of context, connectivity and safety related issues. By merging these two theories and describing the environment as hierarchically structured, Heft is approaching dynamical systems theories such as Bronfenbrenner's 'ecological systems'.

2.1.6 Bronfenbrenner's Ecological Systems

In his theory, sometimes referred to as 'the human ecology theory,' Bronfenbrenner (1917-2005) looked at the environment as a system of organized sets of interrelated parts operating at many levels, each of which serves a function in relation to the activity of the whole system (1979). Although Bronfenbrenner's theory focuses mainly on social systems, the line of thought is helpful in defining physical systems and thus, adds another dimension to the theories of Gibson and Barker, that of scales, which provides the connections and the context.

Bronfenbrenner proposed four primary environmental systems that impact human development: *Microsystem*, *Mesosystem*, *Exosystem*, and *Macrosystem* (Bronfenbrenner, 1979). Each system contains roles, norms and rules that can powerfully shape development. He looked at the ways individuals interact with the environment as a hierarchy of structures or nested systems within which the individual is a participant. He made a systematic analysis of each level in terms of ecological systems and developed a conceptual picture in the form of propositions and hypothesis. In addition to the demand to study individuals in a natural and familiar environment, the propositions emphasize the importance of reciprocal processes, that is, that behavior both influences and is influenced by the behavior of others, directly as well as indirectly. According to Bronfenbrenner, one has to understand how people interact with people, how settings interact with settings, how people interact with settings,

and how settings interact with people. Research should therefore not restrict itself to the study of just one environment, it should examine the complexity of people-environment, people-people, and environment-environment influences on the individual's behavior, that is, the physical, psychological, social, and environmental influences (Bronfenbrenner, 1979).

The family is the most immediate system impacting the child at the micro-systemic level. The meso-system includes transactional relationships between the family and institutions such as school and church, the exo-system influences include social networks and culture, and at the macro system level are cultural values, norms, public policy, and institutional patterns that shape the development of the three other systems (J.L. Frost et al., 1998). Tension among these levels promotes the individuals growth and human development is predicated on the conflict that arises between the individual and her environment (Dixon & Lerner, 1992).

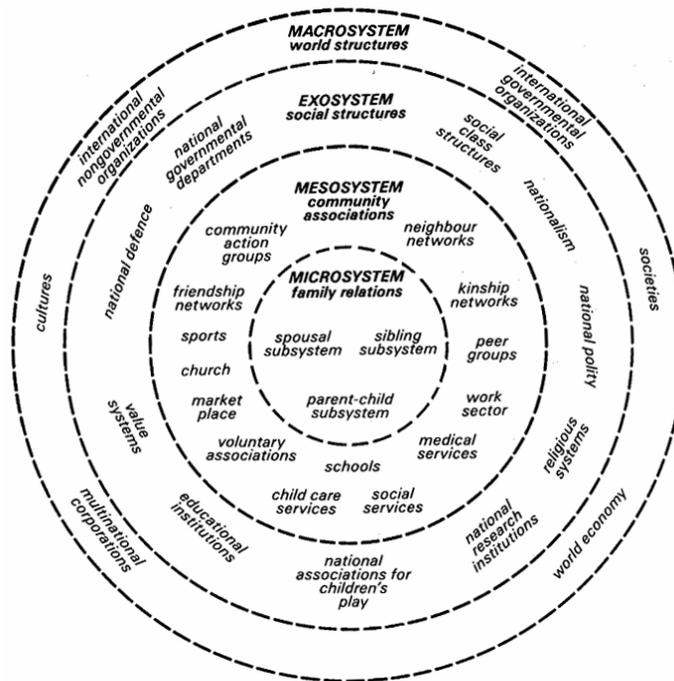


Figure 2: Bronfenbrenner's model as presented by Moore (1986).
Based on a sketch by Reuben Hill, adapted from Bronfenbrenner principles (1979).

Bronfenbrenner's view emphasizes that a child grows up in a complex social environment, surrounded with a distinct case of characters, such as siblings, parents, grandparents, teachers and friends, who are embedded in a larger social system. His argument is that researchers not only must include descriptions of these more extended aspects of the environment but must also consider the

ways in which all the components of this complex system interact with one another to affect the development of an individual child (Bee & Boyd, 2004).

Similarly, Rapoport (1986) conceptualized the environment in two complementary but very general ways: (i) the organization of space, time, meaning and communication, which leads to systems of (ii) settings or cultural landscapes made up of fixed, semi-fixed and non-fixed features. These different settings cannot be considered in isolation, but they can be ordered into a 'system of settings', which makes them preferred on the basis of environmental quality (Rapoport, 1986). The systems are then linked to behavior via systems of activities and communicated by cues which might include: perception, cognition, evaluation, and preference, meaning, supportiveness, and congruence. Starting from the basic ingredients, every element is built up of features that together signal messages to the receiver. Although the object is loaded with signals and the human sensory receptors receive and process the information, the understanding of the data depends on the person's cultural and personal understanding. Thus the object is not loaded with meaning; the person adds meaning to the object or setting. Affordances are determined both by the object and the person (Rapoport, 1986, 1997).

Hence, peoples' behavior can be affected by design and designers can predict outcomes. It's not a matter of forcing behavioral change by design, but to use the design process to accommodate peoples' needs. Using the "softer version" of spatial determinism (Hillier, 1996) as a premise, it can be applied in environmental design, in order that the physical environment can be designed in a way that is directly influential on peoples' behavior. For the designer, spatial determinism therefore means that behavior that will occur in a designed space can be predicted if the means of the physical environment are understood and embedded in the space. The better our understanding of environment and behavior relationships, the greater the chances of fully achieving "places for people" in their most complete, dynamic and interactive form. Design must accommodate the physical, cognitive and emotional needs of the user, and allow constant bi-directional modifications to grow and evolve. The environmental design process is a social act and just as peoples' needs change with time so does design. It is not static and should not be aimed at forcing changes to people's behavior by limiting choices.

2.2 Children's Developmental Needs in Terms of Outdoor Physical Activities

The primary goal with the following section is to review important developmental needs of children, particularly physical activities, the benefits of doing physical activities, and the recommendations for children's physical activities.

2.2.1 The Environment in Child Development: Fundamental Philosophical Views

James Mark Baldwin (1861-1934) and John Dewey (1859-1952) are the two most influential exponents of the constructive interactionism (or transactionalism) view. Baldwin argued that the individual and the social organization are interdependent. Dewey articulated similar views, asserting that development "takes place through the intermediary of the environment... [,] the sum total of conditions which are concerned in the execution of the activity characteristic of a living being (Wozniak & Fischer, 1993)." Dewey's emphasized that the environment needs to offer opportunities for hands-on-learning so that the child can "learn by doing." Thus, the child's knowledge and understanding of the environment is largely based on the child's own experience and the environment, whether the school or the neighborhood, should provide appropriate developmental challenges. According to Dewey, there are two types of freedom. There is "inner freedom" which refers to children's needs to explore and understand objects and events and there is "outer freedom" which refers to children's freedom to move around physically. In both instance, the physical environment plays a major role (Dewey, 2000).

The next step in the development of the constructive interactionism took place in three distant geographical locations during the 1920s with the writings of Jean Piaget (1896-1980), Kurt Lewin (1890-1947), and Lev Vygotsky (1896-1934). According to Piaget (1974), development is a function of the transactions between the child and the environment. It is a gradual change and expansion; advancement from lower to more advanced stages of complexity; the emerging and expanding of the individual's capacities through growth, maturation, and learning (Wong, 1997, p. 84).

Kurt Lewin's 'Field Theory' was an attempt to represent the person and the environment in the graphic terms of topology. He developed a formula showing this relationship $B=f(P, E)$ where P (the person) exists in E (psychological environment) the person's representation of the physical and social influences in the surroundings. P and E together make up the *life space*, the totality of facts inside and outside the person. Outside the life space is a physical world; the individual does not connect to or even know of. The boundaries between the life space and the 'foreign hull', however,

are permeable and the outside can affect the inside and vice versa. The *social* environment and the *perceived* environment were crucial as apparent in his famous dictum “the actual behavior of the child depends in every case both upon his individual characteristics and upon the momentary structure of the existing situation (Wozniak & Fischer, 1993)”.

In his theory of cognitive development (Activity theory), Vygotsky addressed the organizational function of consciousness with an emphasis on the importance of the individual’s interaction with other people and social environment (Wozniak & Fischer, 1993). The key point in his theory is that human intention should be explained by investigating human activity. It deals with understanding the meaning children construct in every day situated actions and understanding the mutually interacting intentional states of the participants (Graue & Walsh, 1998, citing Bruner, 1990). The intentions and the motives are central and what influences the motives is very important, especially, how adult motives shape the resources available to children. It is therefore important that researchers consider both the actions and the culturally defined context that serves as the origin for these behaviors (Graue & Walsh, 1998).

George Herbert Mead (1934-1974) paid special attention to the individual’s experience of the physical environment such as the value play equipment has for a child depends on how the child uses or interacts with it and the individual’s is capability of changing the physical and social environment. This is most evident in small groups or small settings where the organizational structure is less complex and therefore easier to change. Thus, the individual both influences and is influenced by the surrounding environmental forces. As a result of this interaction, the individual learns to behave in a socially meaningful way (Björklid, 1982).

In his theory on psychosocial stages, Eriksson (1902-1994) describes critical periods in personality development, where the individual tries to master core problems which are built on the satisfactory mastery of previous core problem (Wong, 1997). This means that “the child’s development is characterized by a succession of interactional crises or imbalances within his personality structures and between the child and his milieu (Björklid, 1982).” The child tries to manipulate the external environment in order to create a balance between him and the environment. According to Eriksson, this process has two consequences for a healthy development. First, the child’s personality structure is altered every time the child interacts with the environment and future interactions will be different. Secondly, as the child senses to have successfully dealt with the environment, his capacity and willingness to meet new challenges will be stronger (Björklid, 1982). No core conflict is ever mastered completely but remains a recurrent problem throughout life (Björklid, 1982; Omizo, Omizo, & D’Andrea, 1992; Wong, 1997). The critical point in Eriksson’s

theory is that the degree of success a child experiences in meeting the demands of these various stages depends heavily on the interactions the child has with people and objects in his environment (Bee & Boyd, 2004).

According to Gessel's (1880-1961) theory on physical development, children do things at certain times in their development. Maturation (genetically programmed sequential patterns of change) is a developmental unfolding in the child that is not dependent on learning. Readiness for the next step depends on accomplishing the previous one; children are able to do certain tasks at certain times in their physical development such as walk at about 15 months, climb stairs at about 30 months, swing, stand on one foot etc. about the age of three, at age five or six the child masters various complex tasks and can cease being active for a while, and by nine or ten the child has control over his/her body (Bee & Boyd, 2004; Rice, 2001; Wong, 1997, citing Gessel, 1925). According to Gessel's theory, maturation pattern is marked by three qualities: 1. it is universal (appears in all children and across cultural boundaries), 2. it is sequential (involves some pattern of unfolding skills or characteristics), and 3. it is relatively impervious to environmental influences (Bee & Boyd, 2004, citing Gessel, 1925).

Winnicott's (1896-1971) psychoanalytic theory 'the Holding Environment' is not based on stages or sequential milestones. In fact, he emphasized capacities rather than positions or stages, and believed that the human child is all the time at all stages, where there is a wide range of individual differences. The environment receives special attention in his theory. He looked at the individual as born not only into social but also ecological context. According to him, the psychic space between the mother and infant is neither wholly psychological nor physical. It is this psychic space, the environment, which is the caretaker that facilitates the developmental achievements and provides an optimal holding environment, both animate and inanimate - the infant has awareness not only of human touch, but also of the touch of the breeze, the variations in light and color, temperature, texture, and sound (Barrows, 1995; Winnicott, 1965, 1971).

Gardner's Theory on Multiple Intelligences (1983) stems from an interdisciplinary point of view. According to him, intelligence is actually intelligences which rarely operate independently, are used at the same time and tend to complement each other as people develop skills or solve problems. Every individual is incorporated with all of them and the development of each depends on the stimulation and opportunities at hand. The seven intelligences are: (i) linguistic, (ii) logical-mathematical, (iii) musical, (iv) bodily-kinesthetic, (v) spatial, (vi) interpersonal, (vii) intrapersonal (Valdimarsson, 2001). Although the theory is mainly used in education it also adds an important dimension to environmental design and design theory, complimentary to Gibson's theory of

‘Affordances.’ Thus, the environment should be designed with multiple intelligences in mind and provide appropriate affordances or stimulants for multiple intelligences (Gardner, 1983). Gardner later added four types of intelligence to his theory: naturalistic, spiritual, existentialist, and moral. The naturalistic intelligence, which he added to the list of the original seven intelligences, refers to the capacity to recognize, categorize and draw upon certain features of the environment. The naturalistic intelligence contains a connection to the outside world, to animals, plants and the enjoyment of nature activities. It allows people to notice patterns and things from nature easily, enjoy stories, shows or any subjects that deal with animals or natural happenings. It is the foundation of environmental awareness and learning (Gardner, 1999).

A myriad of research and theoretical writings have been executed on the psychological nature and function of the human individual, but until recently, attempts to offer even descriptive taxonomies, let alone theories, of the psychological environment have been scarce (Wozniak & Fischer, 1993). Looking further into the issue of the environment, even less attention has been paid to the physical environment. Until recently, most research on environmental influences on child development has focused on child’s family (frequently only the child’s mother) and on the stimulation available in the child’s home or the family’s economic status. In the past 10-15 years there has been a strong push to widen the scope of research to include the ecology, or the environmental context (Bee & Boyd, 2004).

Wozniak and Fischer (1993) state, that in general, behavioral and developmental scholars have moved towards approaches that emphasize the particularities of persons in context - the particulars of people acting in specific environments and the many complex factors of human body and mind that contribute to action and thought. Activities are now being studied in everyday situations instead of laboratory settings. Children’s active construction of the world around them is treated as fundamentally social in nature, occurring in families, with peers, and in cultures. Behavior is analyzed as changing dynamically, not only over seconds and minutes, but over hours, days and years.

2.2.2 Developmental Characteristics of Middle Childhood

Classifications are useful in terms of sharpening the focus when studying a specific phenomenon such as the affect the physical environment has on school age children’s physical activities. However, and although it is helpful to think about planning the environment for specific user groups, it is important not to loose sight on the continuity in human development in this case, designing the environment in a

holistic way so that it accommodates for the needs of all users from birth to death.

For ease of discussion, human development is often discussed in three basic life span periods: child, adolescent and adult with four basic dimensions: physical, cognitive, emotional and social. Child development is often grouped into subdivisions such as prenatal, infancy and childhood, which commonly is broken into early childhood and middle childhood (Bee & Boyd, 2004).

The focus group in this study is middle childhood, also frequently referred to as the “school age,” and usually refers to the age period from six to twelve years. The beginning of this developmental stage is marked by the defining moment when the child enters school which is when one of the most rapid transitions takes place in a person’s life and the end with the beginning of puberty for most children (Bee & Boyd, 2004).

Historically, the age between six and seven was the time when children were absorbed into the world of adults, gaining responsibilities and work roles. Only in recent centuries have changing concepts of families and formal schooling removed children at this age from participation in the adult society (Ariès, 1962). Any segmentation into age periods will always be somewhat arbitrary and in recent years, this age categorization is, for example, blurred due to earlier schooling age and earlier age of puberty. At this stage, children are characterized by the emergence of a steady advancement of a variety of interdependent physical, mental and social competencies. There are obviously many gradual changes during middle childhood such as increasing physical skills, less reliance on appearance, more attention to underlying qualities and attributes, and a greater role of peers (Bee & Boyd, 2004).

Developmental theoreticians define this period differently. In his theory on psychoanalysis, Freud (1856-1939) characterizes this period as one of latency, where the vital tasks are the development of skills and consolidation of psychosexual achievements from earlier periods. This aspect is also captured in Erikson’s (1902-1994) emphasis on the development of industry and Sullivan’s (1892-1949) interpretation of the importance of interpersonal relationships during this age (Collins, 1984). Eriksson is interested in psychosocial development and refers to this stage as *industry vs. inferiority and inadequacy* and focuses on the age from six to twelve and in his theory on moral development and Kohlberg refers to this stage as *the conventional level* and the age range between seven and eleven. In his theory on cognitive development, Jean Piaget (1896-1980) calls this stage *concrete operation* and defines it between age seven and eleven, the age when children become capable of logical thinking, reasoning and problem solving in a variety of tasks and their thoughts are fully logical and more systematic. Thus, the significant psychological accomplishments of middle childhood are in the realm of intellectual competence (Collins, 1984).

Pollowy (1977) describes middle childhood as a period of relative independence, socialization, and exploration. Physical growth permits practice of complex skills such as bicycling, roller skating, skiing, and the use of tools and practical implements become more important. Six-year-olds are involved in hide and seek, swinging, swimming, baseball, cops and robbers, and playing house. By the end of the seventh year they explore the far environment of the dwelling, and by the eighth year, they are involved in simple organized games, baseball, soccer, skating, jumping, swimming, collections, roller skating. By the ninth year they explore the far environment. They are capable of riding their bicycles to distant points and need the appropriate physical/spatial arrangements and interpersonal and socio-cultural contexts to carry out these activities. They can also use public transportation (depending, of course, on the particular socio-cultural context) (Pollowy, 1977).

Sobel asserts that children this age are “still” fascinated by worms, chipmunks, and pigeons, but their traveling area has extended to friends’ houses, more expansive open areas and streets, woods, fields, ditches, and unused places. They explore generally play within a few hundred yards of their homes, and that their range is often limited to the streets, although where possible children tend to prefer playing in natural or wild spaces (Play Board 1985; Sobel, 1993). From the age of eight to eleven their “homes becomes small, inconsequential, and often move to the periphery of the map (Nixon, 1997).” They head for the woods, fields, ditches, or other unused places they may claim as their own, building forts, playing games, and spying on the world from their hideaways. They are able to orient themselves using prominent landmarks, illustrations of landmarks, aerial photographs etc. to trace activities and activity settings (R. Hart, 1979; R. A. Hart & Moore, 1973; Sobel, 1993). At around 11 years of age most children are able to think in more abstract terms, such as the use of maps, and play games with set rules (R. A. Hart & Moore, 1973; Piaget, 1962) and by twelve they’re drawn toward the social world of the malls, as their “earth period” rapidly wanes (Nixon, 1997).

Physical Characteristics

Physical development includes genetic foundations for development; the physical growth of all the components of the body; changes in motor development, the senses, and bodily systems (Rice, 2001). Middle childhood is highlighted by a noticeable increase in a child’s physical strength, coordination, agility, and flexibility in comparison to early childhood (Omizo et al., 1992). Physical growth is a linear and steady annual growth and there is little difference between genders as far as size and growth rates goes (Rice, 2001). There are however wide individual differences in height, weight, and build among children of this age (Rice, 2001) which is associated with heredity, socio-economic

class, cultural and ethnic differences, nutrition, eating habits, and total health care (Rice, 2001, citing e.g., Widmayer et al., 1990) and exercise (AllRefer Health, 2003). Not all parts of the body grow at the same rate. Growth rate follows the *cephalocaudal principle*: head to feet growth and the *proximodistal principle*: center of the body outwards growth. This is why large muscle development in the trunk, arms, and legs precede small muscle development in the hands and finger (Rice, 2001; Wong, 1997, citing Gessel, 1925). A great deal of variance also occurs during this age when children begin to develop secondary sexual characteristics (Rice, 2001).

School-age children typically exhibit fairly smooth and strong motor skills, but their skills vary widely in coordination (especially eye-hand), endurance, balance, and physical tolerance. During this era in a child's life, fine motor skills increase; they can learn to hammer, saw, use garden tools, sew, knit, write and draw in proportions. Fine motor skills may also vary widely and influence a child's ability to do certain activities. Gender differences in motor skills are due to differential expectations and experiences of boys and girls such as: boys are thought to be superior in physical skills requiring strength and gross motor performance and girls are thought to be better at physical skills requiring grace, flexibility, and agility, such as gymnastics (Rice, 2001).

During this age there is a steady advancement in reaction time. Fourteen years old children are for example almost twice as fast as 5 year olds (Rice, 2001, citing Southard, 1985). Older children have a decided advantage over younger children in sports that require quick reactions. Therefore, many adult sports are not suitable for younger children. Also, in general, activity levels decrease with maturation; consequently, older children are less active than younger children (Rice, 2001). Thus, children at this age are physically more active than their middle and high school counterparts (Trost et al., 2002). Children's activity levels are also influenced by heredity, but the environment plays a leading role in either permitting or inhibiting levels of activity (Rice, 2001, citing Saudino & Eaton, 1991).

Social Characteristics

Friendships and popularity are the main focus of social development throughout middle childhood. Social cooperation and early moral development take on more importance with relevance for later life stages. During this period, children spend more and more time away from home and are centered on the wider world of peer relationships. They learn to compete and cooperate; they learn cultural rules and become members of informal peer groups (Wong, 1997). Virtually, playing with friends takes up all their time outside school (Timmer, Eccles, & O'Brien, 1985) and shared play and plays groups, in

terms of common activities rather than common attitudes or values, characterize this age (O'Brian & Bierman, 1988).

Middle childhood is a time when social controls become co-regulatory in nature and children need to assume a larger share of responsibility for their own behavior in coordination with parents, peers, and others (H. J. Marcus & Nurius, 1984). Hence, the availability and characteristics of friends, peers and family and the ways in which these various people inhibit or promote the development of the focal child is a key factor (Wapner, 1998).

Children's play at this age is also very gender segregated; girls play with girls and boys with boys in their own area and their own kinds of games (Cairns & Cairns, 1994; Harkness & Super, 1985). Boys and girls avoid interacting with one another, show strong favoritism towards their own gender, and negative stereotyping of the other gender (Powlishta, 1995). Boys tend to play in larger groups, are more likely to play outdoors, and roam over larger areas in their play than girls who tend to play more indoors and near the home and school (Benenson, 1994; Gottman, 1986).

Children at this age also behave differently among friends than strangers. Among friends they are more open and friendly, they smile and laughter more, and they cooperate, talk, and help each other more out than with individuals they know less (Newcomb & Bagwell, 1995) yet they are more critical of friends and have more conflicts with them than strangers (Hartup, 1996). The number of friends also increases with school-age; second graders named in general four friends each while seventh graders mentioned about seven (Reisman & Shorr, 1978).

Psychological Characteristics

During this stage, children acquire the ability to reason abstractly, to think in a logical manner, and to organize intellectual functions or performance into higher-order structures. Language, morals, spiritual development emerges as cognitive abilities advance (Wong, 1997). These are all developmental processes that are influenced by heredity and environmental factors (Rice, 2001).

Middle childhood is a critical period in the development of personality and self-concept as it shifts toward a more abstract, more comparative, more generalized self-definition (Bee & Boyd, 2004). There is a major shift in cognitive functioning of children aged 5-7 and 10-12 especially the way in which children's environments and typical experiences "collaborate" in the process of cognitive change (Fischer & Bullock, 1984).

The literature on children's emotional development focuses mainly on early childhood and is scarce when it comes to middle childhood (Wong, 1997). The most apparent characteristics of this stage in regard to the development of self, is what Erikson refers to as *industry vs. inferiority* and

inadequacy. Children at this age absorb all the basic cultural skills and norms, including school skills and tool use and strive for competence and proficiency (Rice, 2001). They are ready to be workers and producers; they want to engage in tasks and activities that they can carry through to completion and they need and want real achievement. Feelings of *inadequacy* and *inferiority* may develop if too much is expected of them or if they believe that they cannot measure up to the standards set for them by others. The ego quality developed from a sense of industry is *competence* (Wong, 1997).

According to Piaget, this is the stage when thought becomes increasingly *logical* and *coherent*. Children at this stage are able to classify, sort, order, and otherwise organize facts about the world to use in problem solving. They develop a new concept of permanence—conservation, and realize that physical factors, such as volume, weight, and number, remain the same even though outward appearances are changed. During this stage, children are able to deal with a number of different aspects of a situation simultaneously. They do not have the capacity to deal in abstraction and solve problems in a concrete, systematic fashion based on what they can perceive. At this stage, reasoning is inductive. Through progressive changes in thought process and relationships with others, thought becomes less self-centered and they can consider others points of view. Thus, thinking has become socialized (Wong, 1997).

In his theory on moral judgment, Kohlberg identified three major levels, each of which has two stages. The target age range is the second level, which he refers to as the *conventional moral level*, the level when thinking increases until it stabilizes at the age of thirteen. During this stage children become less egocentric and more socio-centric. They are concerned with *conformity* and *loyalty*, and have a desire to justify, support, and maintain the existing social structure. At this level in moral development, there are two types of motivation. The first type of motivation is the *good-person morality* of maintaining good relations with and approval of others and the second type is what he calls the *authority-maintaining morality* where the motivation is to maintain law and order and to show concern for the community. They value the maintenance of family, group, or national expectations regardless of consequences. Behavior that meets with approval and pleases or helps others is considered to be “good” and one gains approval by being “nice.” Obeying the rules, doing one’s duty, showing respect for authority, and maintaining the social order is the correct behavior (Wong, 1997?). This is also a characteristic feature in the play as there is a definite modification of, and decline in, symbolic games and an increase in either games with rules or symbolic constructions (Björklid, 1982).

Developmental literature emphasizes children’s attachment to other people and school-aged children are not untouched by separations – they are not yet emotionally self-supporting (Rice, 2001).

Children differ considerably in their reactions to strangers (Rice, 2001, citing Thompson, Connell, & Bridges, 1988) and some children never seem to show much fear at all. Fear of strangers starts to decline at the age of two. Children's sense of security relates to individual differences and their social background experiences (Rice, 2001). Children are less frightened by strangers in familiar surroundings and their sense of security among strangers depends largely on training (Rice, 2001). Another, related issue of interest is overprotection. Rice (2001) states that parents who are fearful for the safety and well-being of their children, may not permit any activities in which there is an element of danger: "[o]verprotected children, whose parents never let them develop autonomy, may become so fearful of making decisions or of doing things on their own that they have difficulty establishing themselves as independent adults."

2.2.3 Children's Needs for Physical Activities

This study focuses on the type of physical activity children engage in within neighborhood. A conventionally defined and generally accepted definition of physical activity is "any bodily movement produced by skeletal muscles that result in energy expenditure (Caspersen, Powell, & Christenson, 1985; D. C. Nieman, 1995)" In this research physical activity (active behavior) is used as the opposite of physical inactivity (passive behavior). A generally accepted definition of 'outdoor physical activities' has not been found and the characteristics of physical activities school-aged children engage in, is scarce.

The health benefits of regular physical activity have been studied and are well described in the literature (D. C. Nieman, 1995; Rowland, 1990b). There is consensus that physical activity is an important determinant of health status, including cardiovascular functioning, skeletal integrity, and psychological wellbeing (Crocker et al., 1997; J.F. Sallis, 1994). Regular physical activity is important for health and wellbeing in general (Task Force on Community Preventive Services, 2002) and structured or unstructured physical activity is essential for children to maintain an energy balance, promote a healthy weight, and support cognitive, physical, social, and emotional development and wellbeing (Burdette & Whitaker, 2005; Ginsburg, 2007).

It is a well accepted principal that play is a basic human need and vital in healthy child development. Children's free play is typically pleasurable, self-motivated, voluntary, imaginative, non-goal directed, spontaneous, active, enjoyable and free of adult-imposed rules (Frost & Jacobs, 1995; Hughes, 1991; Saracho & Spodek, 1998). Although play has been studied heavily in the past 20 years (Joe L. Frost, Wortham, & Reifel, 2001) and a large body of research exists on different forms

of play, there is still limited understanding of the value of play (Pellegrini & Smith, 1998). The fact that a child's physical, social, emotional, and cognitive development can be significantly influenced by play activities is however becoming more recognized. Wong (1997) describes play as a universal medium which allows children to learn what no one can teach them. Through play children learn about their world and how to deal with the environment - objects, time space, structure, and people. They learn about themselves and how they operate in the environment—what they can do, how to relate to things and situations, and how to adapt themselves to the demands society makes on them. In play, children continually practice the complicated, stressful processes of living, communicating, and achieving satisfactory relationships with other people.

Physical Benefits of Children's Physical Activities

One of the major benefits of physical activity is that it helps people improve their physical fitness (U.S. Department of Health and Human Services, 2000), which is a state of wellbeing that allows people to perform daily activities with vigor, participate in a variety of physical activities, and reduce their risks for health problems. Intention to be physically active and perception of benefits from physical activity shows significant correlation (W. C. Taylor & Sallis, 1997).

The benefits of physical activity among youth have been documented for weight, muscular strength (gross motor skills) (Centers for Disease Control and Prevention, 2006; Maden, 1992), aerobic fitness (cardio respiratory, endurance, stamina) (Centers for Disease Control and Prevention, 2001b; J. N. Morris & Hardman, 1997; Nordin, 1997), blood lipids, blood pressure (for hypertensive youth), body composition, glucose, insulin, and psychological health (anxiety and stress, and self-esteem) (T. B. Baranowski & Bar-Or-O, 1992; Centers for Disease Control and Prevention, 2005; J.F. Sallis, 1994). Researchers have also found a correlation between physical activity during childhood and development of skeletal mass (Slemenda, Miller, Hui, Reister, & Johnston, 1991), and hip bone density later in life (Bradney et al., 1998; Lloyd et al., 2000).

Social Benefits of Children's Physical Activities

Although the general benefits of regular physical activity have been studied and are well described in the literature, the psychological and social benefits, which are considered to be as important as the general health benefits, are less clear (Calfas & Taylor, 1994; D. C. Nieman, 1995). Most of the literature focuses on the social benefits of children's play, through which children learn to socialize with other people, learn to establish social relationships and solve the problems associated with these relationships. They learn to give and take, which is more readily learned from peers than from the

adults around them although parental influences are also considered positively influential on children's physical activities (Ornelas, Perreira, & Ayala, 2007). They also learn about the sex role the society expects them to fulfill, as well as approved patterns of behavior and deportment (Wong, 1997). As with play, physical activities are often performed with others, leading to improved opportunities for social interaction, pleasure and personal attention (D. C. Nieman, 1995). Exercise may also stimulate positive family interaction and be a contributing factor in explaining the reduced incidence of delinquency among physically active children and youth (D. C. Nieman, 1995; Weiss & Hayashi, 1995). Closely associated with socialization is development of moral values and ethics. Through physical activities (play) children learn right from wrong, the standards of the society, and to assume responsibility for their actions (Wong, 1997). If they are to be acceptable members of the group, they must adhere to the accepted codes of behavior such as fairness, honesty, self-control, and consideration for others (Wong, 1997).

Psychological Benefits of Children's Physical Activities

Children are born with inherited potentials for intellectual growth, but they must develop into that potential through interaction with the environment. By assimilating information thought the senses, processing it, and acting on it, they come to understand relationships between objects, and between themselves and their world (Wong, 1997). It is primarily physical movement that provides children with the necessary information required by the central nervous system for stimulation whereas adults, on the other hand, achieve such arousal in a variety of non-locomotors activities such as reading, writing, artistic expression, problem solving, and vocational pursuits (Rowland, 1998).

Through exploration and hands-on experiences, children learn about the significance of objects, they learn about numbers, expand language skills and develop an understanding of abstract concepts and spatial relationships. Various types of games help develop problem-solving skills. They learn to comprehend the world in which they live and distinguish between fantasy and reality. They continually rehearse past experiences to assimilate them into new perceptions and relationships. Play provides children with opportunities to be creative, they can explore and try out their ideas through various types of medium and transfer this creative interest to situations outside the world of play. During school-age, creativity is, however, stifled by pressure toward conformity and, therefore, striving for peer approval may inhibit creative endeavors (Wong, 1997).

Through many types of physical activities, children can express emotions and release unaccepted impulses in a socially acceptable fashion, they are able to experiment and test fearful situations, and can assume and vicariously master the roles and positions that they are unable to

perform in the world of reality (Wong, 1997). They can reveal much about themselves, are able to express the needs, fears, and desires that they are unable to express with their limited language skills (Wong, 1997).

Studies support the concept that school-aged children's physical activity and self-concept are related (Gruber, 1986; D. C. Nieman, 1995). According to Winnicott (1960), the process of self-awareness or self-identity is facilitated through play activities. Children learn who they are and their place in the world. They become increasingly able to regulate their own behavior, learn and test what their abilities are and learn to compare their abilities with other people. They become able to assume and try out various roles, and learn the effect their behavior has on others (Winnicott, 1971; Wong, 1997). According to Mead's theory of identity development (as cited by Björklid, 1979) through role-play, for example, the child can observe him or her self from the eyes of other people. Role-play also prepares the child for taking part in games, which is a more complex form of role-play and requires training and understanding of rules developed and roles played (Björklid, 1982).

Although it is difficult to specifically link increases in physical activity with improved self-esteem (D. C. Nieman, 1995; Sonstroem, 1984), it has been suggested that participation in exercise programs is related to improvements in self-esteem (D. C. Nieman, 1995; Sage, 1986). A program of regular aerobic exertion for 20 weeks has for example been shown to increase physical fitness and improves self-esteem (MacMahon & Gross, 1987; D. C. Nieman, 1995). Obese children are at particular risk for having poor self-esteem and being rejected by peers (P. Nieman, 2002). Speculation as to why increased physical activity may be associated with improved self-esteem includes increased sense of self-significance through the experience of and overcoming obstacles and achieving goals, becoming more competent, achieving mastery (control), acquiring a sense of self-discipline, increased social desirability, developing self-preservation strategies and developing social reinforcement (P. Nieman, 2002).

Physical activity is also considered an important therapeutic agent (antidepressant and mood elevation) at any age (D. C. Nieman, 1995; North, McCullagh, & Tran, 1990; Schafer, McCaul, & Glasgow, 1986). Research on the antidepressant mechanisms is, however, speculative at best and only a few studies have addressed the effects physical activity has on specific abnormalities in cognitive and behavioral dysfunctions in children (P. Nieman, 2002). According to Ayres (1979), if the environment does not support the stimulation needed, sensory integration dysfunction or dyspraxia can develop. Therefore, sensory integrative therapy focuses on the child's sensory-motor interaction in appropriate environments. Many children with sensory integration dysfunction lack concentration and have learning deficiency (Ayres, 1979). According to Nieman (2002), limited research has been

done on the effects physical activities have on children with learning disabilities. The bulk of studies have however shown that although physical activity does not increase basic intelligence, it may improve academic performance (P. Nieman, 2002, citing Shepard et al., 1969). Also, physical activities, in particular active aerobics, have been shown to reduce self-stimulation behavior in children with autism (P. Nieman, 2002, citing Watters & Waters, 1980) and regular jogging has been shown to reduce the need for stimulant medication in children with ADHD (P. Nieman, 2002, citing Roth & Holmes, 1985).

Active play serves a useful purpose as a release for surplus energy (Wong, 1997). Cool air helps to modulate the impulse flow from the skin and often reduces hyperactivity, lack of concentration, violent behavior, low self-perception, low self-esteem, and a lack of self-control (Ayres, 1979). Juvenile delinquency among athletic group is also less than in non-athletic groups. There are some speculations as to why this may be such as the use of surplus energy, the satisfaction of increased need for excitement and thrills, and the fact that physical activity provides occupation and thus decreases boredom (Rowland, 1990a).

2.2.4 Characteristics of Children's Physical Activities

Information on the characteristics of children's physical activities is important when designing neighborhoods that encourage children's physical activities. Previous research has identified several general patterns of physical activity among children. Physical activity (energy expenditure at rest and during exercise) has been shown to decline with age (Harrell et al., 2005; J.F. Sallis, 1993; Trost & Pate, 1999; Trost et al., 2002; Welk, Corbin, & Dale, 2000). In fact, physical activity is about 10 percent higher in children than adults (Penny Gordon-Larsen et al., 2000). Exercise energy expenditure also varies by pubertal stage and is higher in pre-pubertal children (Harrell et al., 2005). Elementary school aged children have been shown to be significantly more active than their middle and high school counterparts (Trost et al., 2002). The fact that children of nearly all animal species are more active than adult populations supports the notion that children have an inherent biological need to be active (Rowland, 1998).

It has also been shown that boys are consistently more active than girls (J.F. Sallis, 1993; Trost & Pate, 1999; Trost et al., 2002). When looking at the gender differences for fourth graders in the context of exercise intensity, boys and girls do not differ markedly in daily moderate physical activity but the gender gap in overall physical activity was accounted for by the girls' low participation in vigorous-intensity activities (Trost et al., 2002). These results are supported by other studies and

underscore the need of physical activity intervention programs for girls of all ages. Ethnic minorities have also been shown to be less physically active than European-American adolescents (P. Gordon-Larsen, McMurray, & Popkin, 1999).

The notion that children primarily engage in shorter bouts of physical activity, rather than prolonged exercise, is generally well accepted (Goran et al., 1999, citing Saris, 1986 and Goran, 1998; Welk et al., 2000). Children's every day physical activity should typically be intermittent in nature and involve alternating physical activities with brief periods of rest and recovery. Some of the child's activity each day should be in periods lasting 10 to 15 minutes or more and include moderate to vigorous activity. Extended periods of inactivity are inappropriate for children and a variety of is important (Corbin & Pangrazi, 1998).

In the *Pathways* study, Going et al. (1999) assessed the type and frequency of physical activity among third to fifth grade American Indian students. The results showed that children were most active after school and the activities reported most frequently were (basketball, mixed walking and running) were also found to be the most popular. Walking and running were the most common before school activities and basketball and outdoor play and games were also popular. During school hours running, mixed walking and running, and basketball were most common as well as games such as tag, chase, and hopscotch. After school, running, bicycling, basketball, and horseback riding were the most commonly mentioned activities.

Recommendations for physical activity among children have evolved over time as scientific evidence is constantly being added. The CDC *Recommendations for Physical Activities* (Centers for Disease Control and Prevention, 2006), which are based on The NASPE *Guidelines for Physical Activity for Children* (Corbin & Pangrazi, 1998; Department of Health and Human Services & Department of Education, 2000), focus on the volume of activity and emphasize that intermittent activity is more likely to characterize their behavior than continuous activity. The main goal with the PA guidelines is to promote lifetime activity habits early in life. Hence, it is particularly important to pay attention to the role the physical environment can play in fostering lifestyle physical activities such as providing appropriate and accessible activity settings. The guidelines are developmentally appropriate for physical activity of elementary school age children and consist of four main points:

1. Elementary school age children should accumulate at least 30-60 minutes of age and developmentally appropriate physical activity from a variety of physical activities on all, or most days of the week.
2. An accumulation of more than 60 minutes, and up to several hours per day, of age-appropriate and developmentally appropriate activity is encouraged.

3. Some of the child's activity each day should be in periods lasting 10-15 minutes or more and include moderate to vigorous activity. This activity will typically be intermittent in nature involving alternating moderate to vigorous activity with brief periods of rest and recovery.
4. Extended periods of inactivity are inappropriate for children.

These four points are based on several important concepts relating to physical activity for children (Corbin & Pangrazi, 1998):

1. Young animals, including humans, are inherently active.
2. Children have a relatively short attention span compared to adults.
3. Children are concrete rather than abstract thinkers.
4. Children are active intermittently and need frequent periods of recovery.
5. The relationship between physical activity and physical fitness is not strong in childhood and youth.
6. Physical activity is a significant medium for learning for children and youth.
7. Many, if not most, of the skills used in adult recreation and leisure are learned during the school years.
8. High intensity physical activity has benefits, but may reduce persistence among some people including children and youth.
9. Inactive children are more likely to become sedentary as adults than children and youth who are active.
10. Self-efficacy (a feeling that you can be successful) in physical activity is one of the better determinants of lifetime physical activity adherence.
11. Children and youth who have active parents and family members and who do regular activities with them are more likely to be active than those who are not active in the family.
12. Just as children and youth can learn the habit of regular activity involvement, they are not given opportunities to be active when young.

The DHHS has issued additional recommendations to be achieved by the year 2010. Among those are (i) increasing the proportion of trips 1 mile or less made by walking by 50 percent of the trips and (ii) increasing the proportion of trips to school of 2 miles or less by biking to 5 percent of the trips (U.S. Department of Health and Human Services, 2000).

2.3 Determinants of Children's Neighborhood Physical Activity

The principal objective of this chapter was to identify a variety of settings that are influential on children's outdoor physical activities, in order to underpin those aspects of design that have been identified as important in children's lives; further, to develop a classification of place typology for analytical purposes (see appendix V).

Although the potential effects of the physical environment on healthy child development have been known for some time, this area, as a focus for serious research, has been largely overlooked until recently (Goran et al., 1999; Penny Gordon-Larsen et al., 2000; J.F. Sallis, Johnson, Calfas, Caparosa, & Nichols, 1997). The literature available to date has generally investigated the potential predictors of children's physical activity in each of the four general areas: socio-economic, biological and physiological, psychological, and environmental. Existing data, however, relies largely on cross-referential studies, in which it is difficult to distinguish determinant from correlate (Khol & Hobbs, 1998). No one variable, or category of variables, can be expected to account for most of the variance within children's activity patterns (J.F. Sallis, Simons-Morton, Stone, & al., 1992) and only a small sub-set of the total possible physical environment has been evaluated and emphasize the importance of considering the capacity of the of the physical environment to facilitate or hinder physical activity (J.F. Sallis & Owen, 1997).

Many researchers have focused on the outdoor play environment as being an important "extension" of indoor play environments (mainly with regard to schools and child care centers), and on how the design of these outdoor environments affects the behavior of the children who use them (Susa & Benedict, 1994). While the outdoor environment is clearly a more suitable setting than indoors for the development of stronger muscles and motor skills (Kaplan & Kaplan, 1989), it is imperative that the potential of the outdoors to promote physical development does not detract from other developmental outcomes that can occur through outdoor play.

In a review of literature on physical activity between 1984 and 1995, Taylor & Sallis (1997) state that investigations to date, identifying characteristics influential on physical activity, are limited. Nevertheless, the results from these studies have shown that time spent outdoors is strongly associated with physical activity levels among children. Baranowski et al. (1993) observed physical activities of three and four year olds across a range of physical locations. They reported that activity was considerably higher outdoors than indoors, and concluded that the percentage of time spent outdoors is therefore strongly related to physical activity (T. Baranowski, Thompson, DuRant, Baranowski, & Puhl, 1993; Kleges, Eck, Hanson, Haddock, & Kleges, 1990).

There is also a growing body of evidence for gender differences in the choice of play environments and activities. Boys seem to prefer outdoor environments, and girls prefer indoor environments (Cunningham, Jones, & Taylor, 1994). Boys' preferences for larger outdoor spaces influence the development of spatial orientation. In addition, there are differences in the games and use of play space by boys and girls (J.L. Frost et al., 1998).

2.3.1 The Neighborhood

The term *livability* is a criterion often employed to measure the success or otherwise of open space (Whyte, 1980). When measuring the level of neighborhood livability one also needs to think about *availability* (the level of provision of particular identified attributes in the physical environment), and *accessibility* (the level of access to people and places within/outside the neighborhood) in relation to a variety of formal and informal settings within the neighborhood. Related aspects such as *proximity* (distance), *connectivity* (the directness of travel), *environmental quality* and *convenience* are also important, and can both facilitate and hinder physical activity (Saelens, Sallis, & Frank, 2003).

Many scholars have argued that children have a particularly heavy investment in the neighborhood environment at large but are nonetheless the least represented users in planned residential environments (Coates & Bussard, 1974; Holady et al., 1997). Furthermore, given individual differences (and socio-cultural features), it is important to recognize that there is no environmental setting that will maximize growth and development. Rather, the potential for growth and development can occur in different environmental contexts, and growth and development should be made variable enough to encompass a wide variety of individual differences among children of different ages (Wapner, 1998).

The use of open space for performing a full spectrum of activities, (social, recreational, and functional), is a critical ingredient in making communal spaces meaningful and attractive, and central to the efficient functioning of lively residential environments (Gehl, 1987). According to Rapoport (1986), culture and lifestyle are the principal influence on behavior, activities, and the use of any setting. This is no less true for children. Activities depend on the characteristics of the children themselves, both as individuals and within groups; on the effects of the physical environment; and on the 'mechanisms' that link children to their environment. Thus, activities are linked into systems and should not be considered in isolation (Rapoport, 1986). When studying neighborhood activities, it is therefore necessary to address the full range of settings, and to recognize how play spaces vary in importance, depending on community values, site constraints, and location. The way physical settings

are used will also determine the degree of accessibility and integration possible in that environment (Goltsman, McIntyre, & Moore, 1996).

Heidmets (1985) lists a number of types of spaces which, under the right conditions, might be conducive to a child's physical, mental and social development: the interior space of the multiple family dwelling, the immediate exterior, the school, the playground (both formal and adventure playgrounds), the street corner, the shopping center, the back-alley, the garage, the roof, nearby building sites, vacant lots, the neighborhood, the city sector, the city and its structure. Though these physical aspects of the environment are listed separately, it is important to note, as Heidmets has indicated, that the physical features of an environment serve as a mediator of social relationships, and as a means of fostering healthy development (Heidmets, 1985).

Moore (1986) reviewed available research relevant to children's play behavior, and subsequent development, and provided data on the impact that adventure playgrounds, as opposed to neighborhood play settings, exert on a broad range of play, as it relates to child development. He offered some principles for the planning and design of play environments, including: a) the consideration of the total play environment rather than a focus on playgrounds per se; b) the provision of possibilities for "interaction of children with older siblings, adults and significant others;" and c) the improvement of the whole fabric of children's play in urban, suburban and rural environments (Moore, 1986).

Proshansky and Fabian (1987) identify the neighborhood as one of the most influential settings to have an effect on children. According to them, the neighborhood is more than a physical setting, it defines a social universe. Community-driven spaces, semi-private spaces are of particular importance to children because they identify with immediately accessible domains that foster a sense of neighborhood participation and ownership (Moore & Young, 1978). According to Gehl (2001) "children stay and play primarily where the most activity is occurring, or in places where there is the greatest chance of something happening, particularly in lively, reasonably low, closely spaced buildings that accommodate for foot traffic, good areas for outdoor stays along the streets, and in direct relation to residences, public buildings, places of work, and so forth (Gehl, 2001)." Although the above authors focus on the social environment one could easily argue that the same applies to physical activities.

In all research with children, it is, however, most important to focus on the total outdoor environment, because that is what children use, given their propensity to play anywhere and everywhere. According Goltsman et al., a good play environment contains no less than seventeen types of play and learning settings: entrances and exits, pathways, signage and displays, fences,

enclosures and barriers, manufactured equipment, games areas, groundcovers and safety surfaces, trees and other vegetation, gardens, animal habitats, water, sand and dirt, play props, gathering-meeting-, and working-places, stage settings, field-house and storage areas, and landforms and topography (Goltsman et al., 1996).

2.3.2 Formal Neighborhood Settings

In this study the term *formal settings* is used to describe designed (built) behavior settings that are either confined settings such as yards, parks, playgrounds, school grounds or linear settings such as streets and paths. The following review focuses on confined settings.

Although play areas are just about everywhere, designated play areas are important components in neighborhoods, and are hence the focus of play area studies. Three different types of designed play area have been identified: (i) the *traditional* type with slides, swings, seesaws etc, which commonly is referred to as playground; (ii) the *contemporary* type which typically connects several different components to form a continuous structure that is usually aesthetically pleasing, and often includes undefined enclosed areas for play; and (iii) the *adventure/junk* type which allows children to create their own environment and/or equipment out of old tires, discarded limber, packing crates, and so on (Hayward, Rothenberg, & Beasley, 1974; Ittleson, Prohansky, Rivlin, & Winkel, 1974; Susa & Benedict, 1994).

In 1970, Wallach stated that most research on creativity had focused on creativity as divergent thinking, and had been studied in indoor settings. Research on play had not analyzed how the design of outdoor playgrounds could affect creativity and make-believe play. The few studies done since then have focused on identifying which playground designs are more conducive to pretend-play behaviors, and found that in general that traditional designs are not thought of as being facilitators of imaginative play. Although certain aspects of contemporary designs (such as encapsulation) have been shown to encourage imaginative play (Brown & Burger, 1984), other aspects of it may affect play in other ways, such as intricacy (complexity), diversity, places for interaction, privacy, and retreat, and graded levels of challenge (Susa & Benedict, 1994; Weinstein & Pinciotti, 1988).

Brown and Burger (1984) discuss three important differences between contemporary and traditional playground types: children use contemporary playgrounds more than traditional playgrounds; contemporary playgrounds encourage educationally worthwhile forms of play; and

some specific characteristics of the contemporary playground (for example "encapsulation" or enclosed areas) may promote particular play behaviors (Brown & Burger, 1984).

A study of four different playgrounds demonstrates that elementary school-age children seek different levels of independence and challenge than pre-school children (Hayward et al., 1974). Nevertheless, playgrounds are rarely designed with school-age children's needs in mind. According to Frost (1998), the best playgrounds are developed on the basis of children's natural play needs, taking into account the play behavior engaged in at different developmental periods, including both social and cognitive forms of play. He also states, although not widely researched, that the provision for construction, gardening, and nature areas enhance the outdoor environment. Another issue Frost mentions is that children tend to prefer to play near walls, fences, edges and trees rather than in the center of the playground. They seek out places of seclusion and privacy as spaces to call their own, away from invasion by others, which allows for the freedom to roam and explore (J.L. Frost et al., 1998).

For elementary school-age children it is important to assess for them what they need, as they seek to expand their horizons and interests. Frost et al. determine that the adventure types of playgrounds provide more appropriately challenging and interesting activities for school age children. Hence, traditional playgrounds with manufactured play equipment are usually not designed with older school-age children, pre-teens, and adolescents needs in mind.

Weinstein and Pincotti (1988) examined the effects of the implementation of a tire playground, within a pre-existing traditional blacktop playground, on active and creative play. Their results indicated that after the new materials were added, active play such as running, swinging, and balancing increased, but organized games and uninvolved behavior decreased. The new playground also promoted more imaginative play activities (Weinstein & Pinciotti, 1988). Traditional playgrounds, by far the most common type of designated play area, are mostly limited to gross motor activities, and manufactured equipment falls way short of the potential of outdoor areas to be rich play and learning environments for children (Frost, 1991). The low significance of traditional play areas (Moore refers to them as "official"), relative to other places used for play around the home, has been specifically indicated (Moore & Young, 1978). In a study addressing the impact the environment exerts on children's play and motor development, Fjørtoft (2004) compared physical activities taking place in a natural environment with those in a more traditional playground. Children playing in natural settings showed a statistically significant increase in motor fitness, balance and coordination, compared with those from the other the experimental group (Fjørtoft, 2004).

It is likely that environments rich in resources conducive to physical activity, such as sidewalks, parks, exercise classes, and health clubs, make it easier for people of all ages to be physically active. According to Sallis et al. (1997) previous studies have shown that convenience to facilities affects the scope and intensity of physical activities. Areas with few recreational facilities, safety concerns, or insufficient lighting can hinder physical activity (Saelens, Sallis, & Frank, 2003). In contrast, safer neighborhoods (which include mixed land-use and recreation destinations) facilitate more physical activity (Saelens, Sallis, Black, & Chen, 2003; Saelens, Sallis, & Frank, 2003).

Using data from the 1996 National Longitudinal Study of Adolescent Health, Gordon-Larsen et al., looked at environmental and socio-demographic determinants of physical activity and inactivity. The environmental variables used, seen against the neighborhood context, were: school physical education, use of the local community recreation center; and total reported serious crime within the locality. The results showed that the use of the community recreation center was associated with the likelihood of engaging in high-level moderate to vigorous physical activity; serious neighborhood crime, on the other hand, pointed to a decreased likelihood of falling within this optimum category. Gordon-Larsen et al. also emphasize the need to study other environmental factors likely to affect activity/inactivity patterns, as well as the availability of facilities to accommodate activities, and the question of physical safety en route to pursuing those activities (Penny Gordon-Larsen et al., 2000, also citing Khol (1998), Sallis (1992), and Taylor (1997)). Gordon-Larsen et al. also discuss the need to study environmental factors such as the availability of facilities for activities and physical safety (in addition to crime rates, school PE, community recreation programs) that are likely to impact activity and inactivity patterns (Penny Gordon-Larsen et al., 2000).

2.3.3 Informal Neighborhood Settings (Natural Areas)

In this study, the term *informal setting* is used to describe behavior settings that have not been designed (built). They can be either *confined settings* such as fields, woods, places that collect water, and dump yards or *linear settings* such as trails and dirt bike paths.

In their eye opening book, *The Geography of Childhood*, Nabhan and Trimble (1994) ask *why children need wild places*. Such questions are not uncommon in the academic and non-academic worlds. People wonder about the effects that rapid urbanization and the associated distancing from nature has had, and will have, on children's lives, and quite a few books have been written on this issue.

The earliest finds of modern man go back more than 140,000 years. The first civilization we speak of dates back only about 7,000 years. This means that for more than 95 percent of human history, people lived in hunter-gatherer bands totally and intimately involved in nature and modern urban societies have existed for only a blink of time. With reference to evolution, eco- and evolutionary psychologists are now suggesting that humans are genetically programmed with an affinity for the natural outdoors (Roszak, Gomes, & Kanner, 1995). This concept of innate, hereditary emotional attraction of humans to nature and other living organisms has become known as *The Biophilia Hypothesis*, a term popularized by the biologist E. O. Wilson in 1984. He defined 'biophilia' as "the connections that human beings subconsciously seek with the rest of life", and argued that they are determined by a biological need (Wilson, 1993). Biophilia produces the basis for human's positive physiological and psychological responses to nature, which are important in generating a feeling of wellbeing (Lewis, 1996; R.S. Ulrich, 1993; Wilson, 1984).

In 1987, Colin Ward asked *whether it is true that something has been lost in the relationship between children and their environment*, as he states very many people believe. He speculates about the ways in which the link between city and child can be made more fruitful and enjoyable for both the child and the city. In order to understand the bond children feel with nature, some researchers have focused on studying places that attract children during distinct phases in their lives. Due to physical and psychological comforts associated with trees, vegetated areas are likely to encourage people's use of outdoor spaces and support social interaction than areas without trees (Coley, Kuo, & Sullivan, 1997; Hayward et al., 1974; A. F. Taylor et al., 1998). Barrows (1995) states that people, especially young children who have not yet adapted to the man-made world, consistently prefer the natural landscape to built environments. Furthermore, children have instinctive feelings of continuity with nature which is demonstrated by the attraction they have, for example, for fairy tales set in nature and populated with animal characters (Barrows, 1995).

Sallis et al. (1997) state that features from the natural environment may be influential as a stimulating and positive influence on physical activities. The notion that natural areas encourage physical activity is supported by evidence that people (adults) with easy access to natural areas are more likely to use such areas (Coley et al., 1997; Giles-Corti et al., 2005). For example, people (adults) who use public open spaces are three times more likely to achieve recommended levels of physical activity than those who do not use such spaces (Giles-Corti et al., 2005) and residents of areas with highest levels of greenery are three times as likely to be physically active and 40 percent less likely to be overweight than those living in areas with less greenery (Ellaway, Macintyre, & Bonnefoy, 2005).

In their study on impoverished inner-city housing developments in Chicago, Coley & Kuo (1997) also found that the availability of natural elements conditions the use of outdoor spaces. Their results consistently indicate that natural landscaping encourages greater use of outdoor areas by residents, increases opportunities for social interaction, increases monitoring of outdoor areas, and supervision of children activities. They do not specifically state that contact with nature encourages physical activities; it can, however, be interpreted from their discussion (Coley et al., 1997).

Several studies have found that vegetation greatly affects children's use of the outdoors. Taylor et al. (1998) examined the extent to which barren inner-city spaces actively compromise children's everyday activities and experiences necessary for healthy development. They found that the use of vegetation in has a highly significant impact on the way children respond to those spaces (A. F. Taylor et al., 1998). Informal public open spaces such as open fields, woods, left over areas, hills, ponds, and wetlands, or spaces valued for specific natural features such as vegetation, rock outcrops, and wildlife, are of particular importance to children because they identify with immediately accessible domains that foster a sense of neighborhood participation and ownership (Moore & Young, 1978).

Many scholars have also demonstrated that certain environments, particularly natural ones, may have a restorative or healing effect (Hartig, Mang, & Evans, 1991; Kaplan & Kaplan, 1989; Korpela, Kytta, & Hartig, 2002; Lewis, 1996; C. C. Marcus & Barnes, 1999; Turner, 1976; R.S. Ulrich, 1993; Roger S. Ulrich & Simons, 1986). Ulrich (1993) theorized that the positive responses to natural landscapes might even have an evolutionary basis in that natural selection may have favored those who can relax in a natural setting (R.S. Ulrich, 1993). People also simply enjoy nature—looking at it, being around it, and having it available e.g., (Kaplan & Kaplan, 1989). Also, there is growing evidence that suggests that people fit better in environments that have more nature; that people do better with sunlight, contact with animals, and in settings that include trees, flowers, flowing water, birds, and natural processes than in their absence, and that people develop emotional attachment to particular landscapes. The implication is that we need to create communities and places that resonate with our evolutionary past and for which we have deep affection (Orr, 2002). Thus, if children need contact with animals, plants, landscapes, wilderness, we need to provide them with opportunities that enable direct contact with these attributes.

Several studies have provided clear empirical evidence that seasonal and geographical factors have a direct influence on children's physical activity. Although specific data on geographical variation in children's physical activity is not available, it has been shown that children are less active in winter than during other seasons (Björklid, 1982). It is also hypothesized that children living in

towns and inner cities with milder winters are generally more active, that the physical activity varies month by month (in terms of time spent outside), and that encouragement plays an important role in children's use of the outdoors as a way to increase their activity levels (T. Baranowski et al., 1993). These findings support those of Ross & Pate, i.e. that activity is highest during summer, gradually falling away over autumn and winter, before picking up again in the spring (Ross & Pate, 1987). Baranowski et al. state that further research is needed on the substantial differences and interactions.

Another important factor is landform, a feature usually not considered for other purposes than laying out houses and roads. With such a limited vision, site-planning disregards a child's need for interaction with natural forms, such as topographical diversity and interesting terrain, attributes that greatly enhance the outdoor environment and positively affect children's outdoor activities (Björklid, 1982; Coley et al., 1997; J.L. Frost et al., 1998; Lindholm, 1995; Moore, 1986; Moore & Young, 1978). A study conducted in Sweden by Björklid (1985) across two housing areas, indicates that varied topography, along with the availability of natural elements, fixed play equipment and "play-park," combined with seasonal differences, greatly affect the scope and pattern of children's outdoor activities. However, research has also shown that uneven and hilly terrain can hinder physical activity (Saelens, Sallis, & Frank, 2003). Of other environmental factors posing potential barriers, Sallis et al. (1997) mention inclement weather.

2.3.4 Children's Home-range

"Because they are minimally mobile and spend relatively little time away from the area in which they live, neighborhoods play a special role in children's daily lives (Berg and Medrich, 1980)."

Home-range is closely related to the philosophical concept of territoriality. The terms habitual range, traveling range, exploration range, permissible range and familial space have also been used to describe home-range. Gifford (1997) describes territories as something that may be controlled by individuals, or by groups, and always consists of a space. These could be larger areas such as cities as well as small-scale settings such as a room, or a residential block (Gifford, 1997). Home-range has also been recognized not only as one entity but several such as "free range," and "range with permission (R. Hart, 1979)." Morris & Hess (1975) assert that one of the gauges for the "homeliness" of a neighborhood would be whether or not the inhabitants can easily walk its boundaries. According to them, the size of a neighborhood should not be so large that going from one side to another

requires special effort, and that its physical size affords a reassuring sense of familiarity for everyone within its boundaries (D. Morris & Hess 1975). Moore and Young (1978) used the term “habitual range” to represent

“close to home behavior, incorporating friendship patterns clustered around each child’s home, spilling out onto sidewalks, and extending into more accessible neighborhood spaces such as schoolyards, playgrounds, back alleys, lawns, vacant lots, small vegetated grassy areas, etc., where peers can play together. Habitual range is particularly appropriate to the evaluation of residential districts...”

In increments, school-aged children’s home range grows from the familial space, or domestic level, to the neighborhood level (Nixon, 1997). These step-by-step expansions are accompanied by changes in general cognitive development (Björklid, 1982; R. A. Hart & Moore, 1973; Moore, 1986). Research has also shown that freedom of movement has positive effects on children’s cognitive and behavioral development (Risotto & Tonucci, 2002). Most studies have found boys to be more advanced than girls, not because of differences in spatial skills, but due to the fact that in many societies boys are accorded greater freedom to explore (or they may be more bold in challenging parental restrictions) (Moore & Young, 1978; Spencer & Wooley, 1998). Wardle (1990) argues that greater freedom afforded children in outdoor environments may provide them with greater opportunities to direct their own learning, and to select the kinds of play that interest them. Wardle maintains that such opportunities are particularly important in contemporary society where the scope for quality, child-initiated play is decreasing (Wardle, 1990). By the age of seven, they head for the woods, fields, ditches, or other unused places they may claim as their own, building forts, playing games, and spying on the world from their hideaways (R. A. Hart & Moore, 1973; Piaget, 1962). According to Pollowy (1977) by the age of nine, they explore the far environment. They are capable of riding their bicycles to distant points and need the appropriate physical/spatial arrangements and interpersonal and socio-cultural contexts to carry out these activities. They can also use public transportation (depending, of course, on the particular socio-cultural context) (Pollowy, 1977).

Children’s home-range is affected by obstacles including traffic, lack of sidewalks, and fear of crime (Berg & Medrich, 1980). Children who cannot play unaccompanied in their living surroundings are worse off with regard to motor skills development, social behavior and overall independence than children from higher quality neighborhoods (Hüttenmoser, 1995). Children allowed to go without an adult on a bus, streetcar or metro went out on more trips from home and did so for greater range of activities (Van Vliet, 1983). The findings from a study on children’s independent movement in two urban areas in London, showed that children, particularly boys, who

were allowed out without an adult go out more after school, and so have more chance to be active and sociable (Mackett, Brown, Gong, Kitazawa, & Paskins, 2007). Another British study identified four factors that affect children's journey to and from school in the 1940's: (i) the availability of transport technologies as car ownership spread to the majority of the population by the late twentieth century, (ii) an increase in parental choice of schools which has led to greater distances traveled and more time spent for this purpose, (iii) increased pace of life which has led to people attempting to cram more activities into limited amount of time, and (iv) perceptions of risk such as "stranger danger" which has affected the degree of parental control that is exercised over the journey to school, and the extent to which children are allowed to travel to school alone (Pooley, Turnbull, & Adams, 2005).

Children's permissible range is also an important concept and closely related to the discussion of home-range. Here the term is used to describe the physical boundaries or limits set by parents or other 'authoritarians' such as teachers and the police. This constitutes more of an official range - "you are not allowed to go...."- and might determine, for example, how far the child is allowed to stray from the home. Thus, children's access to their neighborhoods is also dependent on parents' assessment of environmental risk, the age and gender of the child, and parents' assessment of the child's capabilities (Holady et al., 1997). In a study by Hüttenmoser, (1995), of five year olds in Switzerland, a correlation was found between the quality of children's "living surroundings" (neighborhood quality measured in terms of the presence/absence of traffic danger and play areas), the time children spend outdoors, adult supervision needed, and opportunities for social contact with other children (number of play pals and child visits).

Permissible range is usually based on clear boundaries or landmarks known to both the child and the authority, such a street, a fence etc., and greatly affects children's travel/play patterns and freedom to explore the environment. Because the neighborhood is the exploration area for children of this age, boundary-providing elements, determined by edge-lines and/or features such as prominent landmarks, gates, fences, walls, vegetation, paths, streets, enclosures, and barriers become important reference points. Boundaries are also one of the seventeen most important landscape features mentioned by Moore (1986) and Goltsman (1996) and places to meet friends (Gehl, 1986).

2.3.5 Linear Settings and Walkability

In this study the term *linear settings* is used to describe settings that connect confined settings, points of destination, or other linear settings) such as streets and pedestrian paths. Such settings afford non-localized access such as biking or walking to school- activities. The term is used to describe a place

where the purpose of the activity is not the activity in itself, but a by-product of another goal-oriented activity. Thus, the activity is not the main purpose, but a setting needed to be able to perform another activity such as; the child uses the sidewalk (location) to bike (by-product activity) to the ball field (destination) to play ball (goal-oriented activity). The term is used in a similar way as Kevin Lynch (1960) defines “paths”:

“Paths are the channels along which the observer customarily, occasionally, or potentially moves. They may be streets, walkways, transit lines, canals, railroads. For many people, these are the predominant elements in their image [city image]. People observe the city while moving through it, and along these paths the other environmental elements are arranged and related”.

There are two terms that are helpful when thinking about place accessibility: connectivity and walkability. Connectivity refers to the physical proximity between places. Interconnected networks of streets create connectivity. Although it has been shown that paths that are designed to encourage walking reduce the number and length of automobile trips, and conserve energy (Randall & Baetz, 2001), pedestrian access and acceptable walking distance to public open spaces has been severely restricted in urban planning (Southworth & Parthasarathy, 1996). Attributes that stimulate more pedestrian travel in the neighborhood can be the addition of sidewalks, access pathways to isolated cul-de-sacs, connections to regional transit networks, greater variety of intra-neighborhood destinations (commercial and employment activities) and improving the aesthetics of the street environment (Randall & Baetz, 2001). Walkability is a gauge of the accessibility and recreation opportunities for pedestrians, and considers pedestrian safety, convenience, and route aesthetics (Centers for Disease Control and Prevention, 2006). It is used to measure both the directness of route, distance, and the degree of ability to reach certain places by foot. The term is used to describe activity areas of daily living within walking distance from children’s home and work (in the case of children, schools), allowing independence to those who do not drive, especially the elderly and the young.

Overweight and obesity has been associated with neighborhood’s level of walkability (Saelens, Sallis, & Frank, 2003), lack of sidewalks and lack of walkability to stores (Giles-Corti et al., 2005), land-use mix and distance walked (L. D. Frank, Andersen, & Schmid, 2004), and neighborhood deprivation (van Lenthe & Mackenbach, 2002). Other environmental attributes positively associated with walking include higher residential density and smaller street-blocks around home, and shorter distances to food and daily retail facilities from home (Vernez Moudon et al., 2006). Since children’s mobility is believed to be a major determinant of their overall physical

activity and is furthermore highly dependent on the availability of, and accessibility to, appropriate and safe play areas, they also become important determinants on children's physical activity (Goran et al., 1999).

Moore and Young (1978) note that the most salient physical aspect of a child's reported favored place is its immediate accessible environment within the neighborhood. How children experience their neighborhoods, and extra-familial sources of support, are influenced by the accessibility of such experiences. Thus the means by which the child reaches its favored places (walking, riding a bike, traveling by bus or by car) within neighborhoods is a very important influence on its range of activities. According to Moore and Young, accessibility can also, in part, reflect the adult sector's commitment to children. Settings such as community pools, parks, schoolyards, libraries, and recreation programs offer examples of formal adult and community support for children's activities.

In previous sub-chapters the settings discussed typically concerned localized activities, but as Francis (1985) states, non-localized activities dominate children's outdoor activity in the neighborhood environment. He states that "even when faced with diverse play opportunities provided by innovative site-planning, (such as new forms of community space, vineyards, orchards, natural drainage areas, and common areas); the majority of children's outdoor activity took place in the streets and pedestrian/bike paths traversing the neighborhood." Of all open space areas, the pedestrian/bike paths were most heavily used (24%), followed by neighborhood streets (20%), common areas/greenbelts (14%), open drainage areas (8%), and two large turf areas (12%). Even when a diverse, safe, and accessible green open space system was provided, children still chose to use the street as one of their major activity areas, especially cul-de-sacs with slow moving traffic (Francis, 1985).

Since children's mobility is restricted they spend a great deal of time in the neighborhood. Nevertheless, school-aged children's time for free play decreased dramatically from 1981, when the average child enjoyed about 40 percent of the day for free activity (hours left over for sleeping, eating, studying, engaging in organized activities and free play). In 1997, the figure was down to 25 percent (Kirn & Cole, 2001). All the above factors have resulted in children's diminished freedom to explore their surroundings and learn from their own experiences, and fewer opportunities for healthy social interaction e.g., (Rosenbaum, 1993).

Although Abu-Ghazzeh (1998) states that "Streets should be destinations, not routes", the fact is that streets in suburban neighborhoods are usually designed for automobile use only. Little or no emphasis is placed on designing streets as public settings for a variety of uses and a diversity of

users. Issues relating to pedestrian safety, street hierarchy, street types, interconnectedness, as well as aesthetic appearance, are rarely placed high on the agenda, although they are particularly important in influencing children's behavior patterns and scope of activity. Children are the principal users of neighborhood streets and therefore residential streets need to be designed to accommodate the needs of all users and uses, including children's leisure time activities e.g., (Francis, 1981; Moore, 1986, 1987; Moore & Young, 1978).

The city of Delft in the Netherlands has one of the most original programs for converting conventional residential streets into creative, pedestrian-oriented spaces called *woonerven*. The Eubanks-Ahrens (1991) study of two 'woonerven' showed that adapting streets, particularly those streets designed to serve through-traffic (and still do, but in a balanced auto/pedestrian way), not only encouraged children to play longer, but also allowed play to become more complex. Increase was also noted in children's length of stay, games requiring more space, and good playing surfaces. A drastic increase was noted in the use of bicycles and wheeled toys, more fantasy play, music making and dancing (Eubanks-Ahrens, 1991). The *woonerven* design concept has provided for the essential street life that Jane Jacobs (1961) advocated, adding opportunities for children to be in contact with the adult world (J. Jacobs, 1992).

2.3.6 Neighborhood Safety

Margaret Mead (1966) suggested that a child's encounters with the familiar and the strange are important events in understanding the urban experience. Depending upon the setting, the family, and the child, urban neighborhoods have physical and social qualities that are either of interest or potentially dangerous to children (Blakely, 1994).

Social and physical safety issues such as increased levels of violence and the perceived and actual dangers to children have been mentioned as influential factors limiting physical activity (Goran et al., 1999; Penny Gordon-Larsen et al., 2000; Khol & Hobbs, 1998; J.F. Sallis, Johnson et al., 1997; Striniste & Moore, 1989).

As children are the primary users of the outdoor neighborhood, and use streets directly as their traveling and play environment, traffic poses a considerable risk to their safety. Not only that, it further affects their quality of life and developmental growth (Björklid, 1982; Rosenbaum, 1993). As stated in the Mean Streets report 2000, pedestrian safety has been severely neglected (Surface Transportation Policy Partnership, 2000). The average person spends 73 minutes/day driving, and 89 percent of all trips are made by automobile, while only 6.4 percent are made on foot or bicycle

(Lanham, 1997). In the past 20 years, a period during which traffic levels in the U.S. have nearly doubled, children's independent mobility has declined dramatically (Hillman, Adms, & Whitelegg, 1990). Of course children also benefit from being driven to places in cars, but the downside is considerable. One of the principal threats to their safety in the physical environment is posed by traffic. Younger children in particular lack skill and experience. Their observation and listening powers are less fully developed, and their small stature, which means they are less likely to see and be seen, along with their general immaturity of judgment, all lay them open to danger in traffic situations (Rosenbaum, 1993, p.58). The consequences of traffic danger for children's quality of life and development are extensive. Since children depend more on walking they are at greater risk of an accident than adults, especially in suburban areas.

According to a Scottish study of cues children use to appraise the risk of crossing roads, children (aged 5-7) tend to use the presence or absence of cars in their view as their criterion for crossing roads and do often not consider oncoming cars that might be obscured from their view by parked cars or shrubs. By age eleven or so, most factor the possibility of hidden cars (Ampofo-Boateng & Thomson, 1991). Restrictions are imposed due to fear of traffic and crime and lack of time for parents to supervise their children's outdoor activities (Davies, 1996; Francis, 1985; Whyte, 1980). In rural areas, problems of access to the countryside can also arise by the loss of public footpaths, and the need to keep children safe from farm machinery and pesticide stores (Ward, 1978).

Children's access to their neighborhoods is also dependent on the parents' assessment of environmental risk, the age and gender of the child, and a gauging of the child's capabilities e.g., (Holady et al., 1997). Parents are afraid of their children's safety when they leave the house alone; many children are no longer free to roam their neighborhoods, or even their own yards, unless accompanied by adults. The findings from a study on children's independent movement in two urban areas in London, showed that most children aged 8-11 were allowed out without an adult, but many of them, particularly girls, were only allowed out with other children (Mackett et al., 2007).

Kohl & Hobbs (1998) discuss the physical safety within children's environments: "Given that time spent outdoors is strongly related to physical activity, an increasingly important determinant of physical activity is the physical safety of the surroundings and environment." To support their argument, they refer to *The Youth Risk Behavior Surveillance System*, where it is reported that nationwide 4.4 percent of students missed at least 1 day from school during the preceding 30 days, because they felt unsafe at school, or unsafe traveling to or from school. From this data Kohl & Hobbs conclude that safety/risk factors are likely to reduce motivation, or be actual barriers to physical activity (Khol & Hobbs, 1998).

Berg and Medrich (1980) investigated the relationship between children's play patterns and the qualities of neighborhood physical environments. They looked at problems of safety and mobility and found that since children are minimally mobile, and spend relatively little time away from the area in which they live, the neighborhoods themselves play a special role in their daily lives. Because they are restricted to their neighborhood, or its vicinity, they are major producers and carriers of neighborhood life including its assumed dangers (Berg & Medrich, 1980).

The space within which children can move freely diminishes significantly as street traffic increases in the immediate environment (Appelyard & Lintel, 1972). Forty percent of parents asked about the barriers to children walking to school cited traffic as a major concern (Surface Transportation Policy Partnership, 2004). Pedestrian injury is the third leading cause of unintentional injury-related death among children ages five to fourteen. This is true even though the evidence shows that fewer children are walking. Only about 14 percent of children's trips to school are made on foot, down from 50 percent in 1969 (Surface Transportation Policy Partnership, 2004).

2.3.7 Children's Favorite Places

In an extensive study on children's environments conducted across two neighborhoods in England, Moore (1986) studied the neighborhood environment, as depicted via children's drawings and notes from child-led fieldtrips. The list he drew up of children's favorite places points to lawns, playgrounds, schoolyards, and the child's home as the most significant. Local parks, single trees, streets, pavements, other dwellings (homes of friends, relatives and baby-sitters), fences, and footpaths were also popular. In the third category of importance were places and objects, such as swimming pools, sports fields, flowers and miscellaneous structures, ponds and lakes, shrubs, school, friends, traffic, bridges, topography, dirt and sand. This is one of a number of studies that have examined children's perceptions of their neighborhood characteristics, and their preferred sites for activities. These studies consistently establish that children seek outdoor sites that allow active use of the environment, especially away from adult supervision e.g., (Francis, 1985; Medrich et al., 1982; Moore, 1986; Schiavo, 1988; van Andel, 1984).

According to Schiavo (1988), who studied age differences in the assessment and use of a suburban neighborhood among children and adolescents, place preferences change with age (Schiavo, 1988). Malinowsky and Thurber (1996) studied children aged eight to sixteen, in a residential summer camp where they traced the development of place preference. They found that the younger

children chose places on the basis of affordances, while the older ones tended to choose places for their aesthetic or cognitive qualities (Malinowski & Thurber, 1996).

In a study of adult memories of significant settings from their childhood, Sebba (1991) reported that almost all the adults identified outdoor places, usually experienced without adult mediation. According to Sebba, adult memories reflect actual childhood preoccupations (Sebba, 1991). Woolley et al. (1999) interviewed several hundred ten to twelve year olds and found that places for quiet reflection are as important to children as are some of the more obvious attractions of the town. They also found that among the things that children dislike most, are ‘insults’ to their vision of how their the neighborhood environment should be: incivilities, dirt, litter, graffiti and other signs of people not caring for the place or its fellow users.

2.3.8 Summary of Neighborhood Determinants for Children’s Physical Activity

In this chapter, several physical settings and factors were identified that have, or may have, influence on children’s outdoor physical activity. The emphasis should be on the total environment: the systems of settings; the points of destination and the routes that connect them; as well as on the affordances specific settings offer. Another important aspect in this context is the ages of the children, as needs for activities and preferences of places change with age and may differ by gender.

Two basic factors that determine whether children use the physical settings in their neighborhood are the availability of appropriate settings and accessibility to them. However, availability and accessibility can be highly restricted by environmental as well as social factors. Streets are, for example, places children would like to use for play, but traffic is a great threat to their safety. Another related factor is children’s need for mobility – the possibility to get safely from one place to another. Safe and accessible places are necessary for children’s healthy development. Thus, short distances between attractive places and the possibility to get there on foot – the accessibility, connectivity and walkability of neighborhoods - are positive features of those neighborhoods. They encourage children to move independently and freely. Higher residential density (physical and population) is also thought to encourage physical activity, because it is likely to increase the number of play pals and decrease the distance between them.

In this context the size of a neighborhood, characterized by physical settings such as borders and landmarks, plays an important role. How far a child is allowed to, or dares to go, from his or her home depends partly on its orientation in the neighborhood. Clear landmarks and borders support children’s orientation, and also communication between parents and children about the habitual

and/or permissible range. A lack of clear boundaries or paucity of appropriate landmarks may lead to parents choosing to restrict the home range, and can therefore have a negative effect on the outdoor activities of children. Children's habitual range increases with age, and they become increasingly able to orient themselves at a larger scale. Different types of boundaries and landmarks that serve as boundary-providing elements are also important for social contact, as they often become central meeting places. On the other hand, overly strict boundaries between neighborhoods and bad connections from suburban communities to town centers may result in neighborhood isolation. The magical solution is to think of the environment (boundary providing elements) as a system that provides developmental stepping-stones into the larger environment, physical and social.

Children's activities take place anywhere and everywhere within the neighborhood. The total neighborhood environment can be divided into two ideal groupings; (i) a variety of formal outdoor settings – such as private yards, designed play areas, and streets and (ii) informal settings – such as paths and natural areas. As an example of formal settings, the design of play areas was found to have a profound effect on children's play and behavior. Creative and imaginary play, physical exercise and social contact changes depending on the presence or absence of play material provided on different play grounds. Also the age of the children has to be taken into consideration when designing a play area, taking into account the play behavior at different developmental periods of a child's life.

The physical settings of an ideal neighborhood should always contain a variety of informal settings. Ideally, the natural landforms and topography of an area should be incorporated into the design of the neighborhood, providing children with a rich play environment that also encourages lingering, cognitive activity, and the simple act of ambling through. Various types of vegetation, especially trees, have a greatly beneficial impact on children's outdoor activities. Contact with nature has been found to constitute a basic requirement of healthy child development.

It can be concluded that the design of the neighborhood environment should consider the needs and demands of children much more than current practice allows for. The design should take into account how children move around within their neighborhoods, and their patterns of play in relation to where they live within those neighborhoods. Formal physical settings such as landmarks, borders, paths, safe streets, and designed play areas are clearly on a par, in importance, with natural settings and informal? These physical settings should take into consideration those factors that are known to affect children's outdoor activity such as mobility, and safety. Since the time spent by children outdoors is a fundamental influence on their physical activity, an attractive physical environment within the neighborhood can be expected to make a vital contribution to children's active lifestyles.



3 Methodology

This chapter explains the methodological approach through a discussion of the research methodological paradigm and detailed review of decisions concerning the research design including the context of the study, case selection, population selection, data collection and analyses.

3.1 Research Design

In order to assess the quality of the physical environment in terms of children's outdoor physical activities this study examined school-age children's outdoor physical activities in relation to a variety of neighborhood settings. The degree of neighborhood supportiveness of children's physical activities was assessed by studying the relationship between neighborhood morphology and children's outdoor, out-of-school, physical activities, the physical settings they seek, their mobility within the neighborhood, and their most favorite places.

3.1.1 Research Aims

Various lifestyle-related health problems, such as poor fitness and overweight among school-aged children, have emerged as major public health concerns. Although the multifaceted pathways leading to the development of such problems are not well understood, relationships between physical activity and the neighborhood environment have been hypothesized. Recent research focusing on environment/activity relationships has mostly been conducted in disciplines other than environmental design, and has largely been focused on socio-economic factors although researchers have increasingly been turning their attention to the quality of the physical environment the physical in the search for possible explanations.

The main objective of this research was to acquire a better understanding of the associations between environmental mechanisms associated with the development of sedentary behavior by examining the relationship between suburban neighborhood morphology and school-aged children's

outdoor, out-of-school, physical activities, the physical settings they seek, their mobility within the neighborhood, and their most favorite places. Such research may provide information that can guide intervention and policy efforts to prevent sedentary behavior among children in the future. It is expected that multidimensional neighborhood profiles can be identified as important environmental indicators of activity and sedentary behavior patterns, independent of individual child characteristics. It is hoped, that the findings will go some way towards filling the gaps in current understanding of the relationships between activity patterns and the quality of the neighborhood environment. Four specific aims were identified for this study.

1. The first aim was to explore the relationship between neighborhood morphology and children's outdoor, out-of-school, physical activities. Of interest was the examination of children's outdoor physical activities in relation to a variety of neighborhood settings: i) *private settings* such as friends' homes and yards, ii) *formal settings* such as sidewalks, parks and playgrounds, iii) *informal settings* such as paths and natural areas, and iv) *indoor facilities* such as schools, commercial and recreational facilities. The relationship between the availability of recreational facilities within the neighborhood and children's participation in organized physical activities and parents' perception of opportunities for children's outdoor activities and neighborhood safety was also studied. Data on physical activities children seek outside the neighborhoods was also collected to further determine the impact neighborhood morphology has on children's physical activities.
2. The second aim was to explore the relationship between neighborhood morphology and children's mobility within the neighborhood as walkability is believed to be a major determinant on children's physical activity. Special attention was paid to linear settings, the location of the elementary school, and the geographical extent of the built neighborhood environment in relation to distances traveled, and parents' perception of children's safety.
3. The third aim was to study the relationship between neighborhood morphology and children's favorite places as it is believed that neighborhood affordances in terms of interesting settings for children may be a key stimulant for children's physical activities. Children's actual use of favorite places was also of interest in this research.

Two other specific functional objectives were identified for this study:

1. This study was set out to further develop functional classification of school-aged children's physical activities and physical settings for research and planning purposes. This objective addresses the fact that recent public health research has mostly been concerned with the

- intensity of activity, rather than the types of physical activities children are engaged in and where they take place.
2. The second specific objective was the advancement of methods to explore environment-behavior relationships, using quantitative and qualitative data-gathering methods, including an illustrated children's activity log. The research methods used in previous public health research have mostly been quantitative and have therefore not provided in depth information, or explored other possible contextual field information. This study presents a unique opportunity to further develop the design of the data-gathering tools currently used in this area of research, especially as it relates to child-friendly design of instruments used.

3.1.2 Research Assumptions

In order to eliminate any possibility of misunderstanding, the research rests on two main assumptions:

1. The design of the outdoor physical environment in residential neighborhoods is a major determinant on children's outdoor physical activities.
2. Children's outdoor physical activities are important developmental functions affected by physical, social, economic, and environmental factors.

3.1.3 Research Questions

The research questions address the more general issues of contemporary suburban neighborhood design as it relates to children's needs for physical activities. The questions provide a broad framework for discussion purposes and are aimed to provide a general conclusion statement. Research question number two was divided into five sub-questions that focus on a more specific area of inquiry:

Research question 1: physical activities

What is the relationship between neighborhood morphology and the types of outdoor, out-of-school physical activities children engage in?

Sub-question:

1. What is the relationship between neighborhood morphology and children's engagement in organized physical activities?

Research question 2: physical settings

What is the relationship between neighborhood morphology and the types of physical settings children seek?

Sub-question:

1. What is parents' perception of opportunities for children's outdoor physical activities?

Research question 3: mobility

What is the relationship between neighborhood morphology and children's mobility?

Sub-questions:

1. What types of non-localized, outdoor, out-of-school, neighborhood physical activities are children engaged in?
2. What types of linear neighborhood settings do children seek?
3. What is the total distance children travel by foot or bike within the neighborhood?
4. What is the distance children travel by foot or bike to and from school?
5. What is the relationship between neighborhood morphology and parents' perception of children's physical and social safety?

Research Question 4: favorite places

What is the relationship between neighborhood morphology and children's most favorite places?

The independent variable is neighborhood morphology. The dependent variables are: (i) children's *physical activities*: lifestyle activities, cardiovascular activities, flexibility and strength exercise and rest and inactivity, (ii) *physical settings* children seek: private settings, formal settings, informal settings and indoor facilities, children's *mobility*, and children's *favorite places*. The definition and classification of dependent variables is explained in chapter 3.6 Criteria for Data Analysis and the typology classification is presented in appendices V and VI.

3.1.4 Conceptual Research Design

The following diagram provides an overview of the conceptual research design applied:

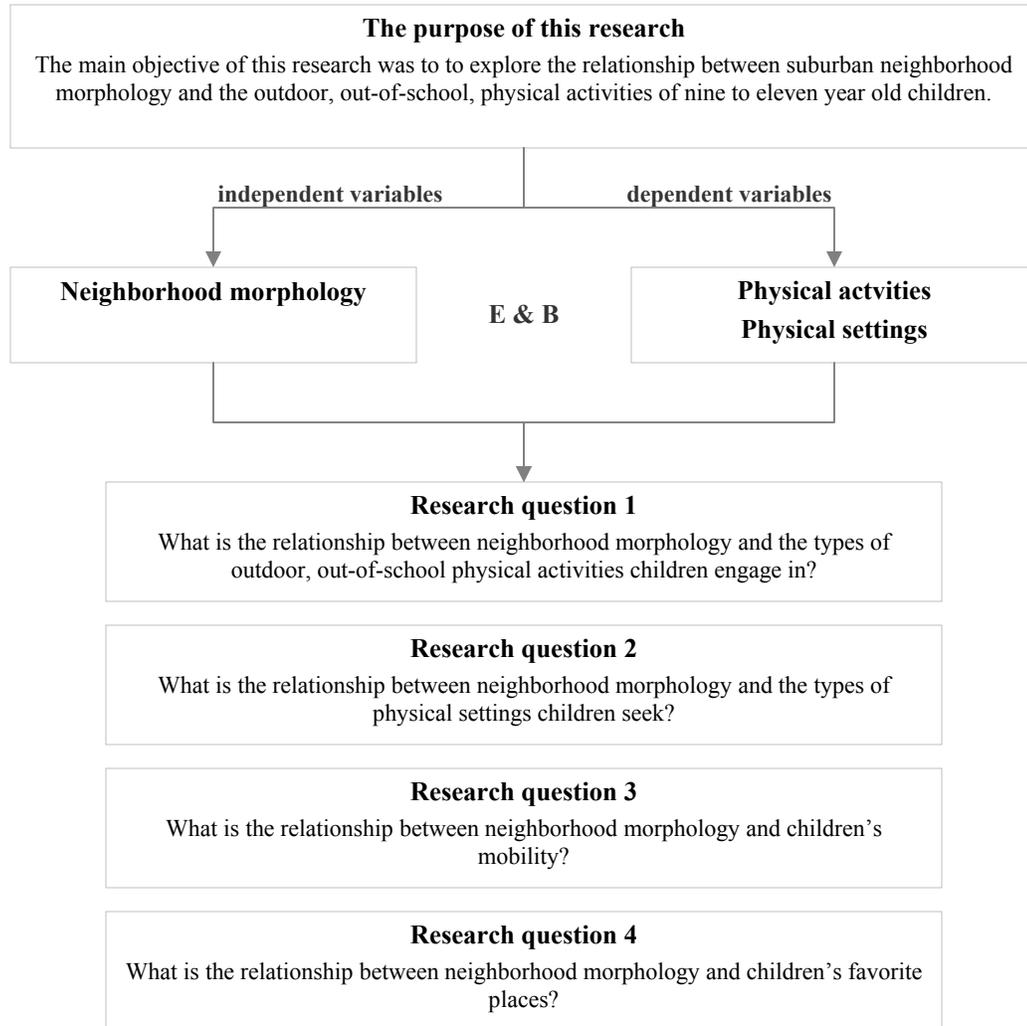


Figure 3: Conceptual research design

3.2 Methodological Approach

Environment design research (environment and behavior research) is applied and interdisciplinary in nature and is typically applied field research. The goal is to understand the function of the physical environment and the ways it affects human behavior and well-being, and to use the information gathered to affect the quality of real design situations. The results are often used to develop design guidelines for the specific situation.

Bechtel et al. (1987) describes environment design research like “jumping hurdles” as it does not fit any particular tailored approach as is the case in most other fields. Actually, the research focus is the interaction that takes place between the human being and the environment in question, and how the designed environment provides opportunities for specific types of behavior. According to Bechtel et al., using multiple methods for data collection is essential in design research, in order to cover adequately the many different considerations. That is, considerations that flow from the need to concentrate on environment, individuals and groups, different kinds of individuals and groups, and more, in addition to the need for validity. This argument they use to state the need to examine environmental design research on its own terms and in greater terms because it involves unique methodological consideration (Bechtel, Marans, & Michelson, 1987).

The physical environment is a complex phenomenon where no one setting is exactly like any other. Each varies in size, scale, structure and nature. They are living, interconnected systems that are affected by social, economic and physical factors. Although the complex nature of the environment is the most interesting part in environment design research it also makes the identification and examination of independent variables difficult. The fact that the field borrows paradigms and methods from other more established disciplines brings strength to design research in relation to measuring the dependent variables.

The methodological framework is based on a multi-method approach with a multiple case study field research strategy. According to Creswell (1994), case studies are typically described as an approach “in which the researcher explores a single entity or phenomenon (“the case”) bounded by time and activity (a program, event, process, institution, or social group) and collects detailed information by using a variety of data collection procedures during a sustained period of time” (Creswell, 1994). Although case studies may be qualitative, quantitative or a combination of the two its sampling approach case study research follows a similar sampling logic with qualitative studies as opposed to quantitative ones (Yin, 1989). According to Leedy and Ormrod, almost any phenomenon can be examined by means of the case study method; an individual, a program, a school, an organization or even a community. What he says is similar to such studies is an in-depth study of a phenomenon of each case in its natural setting and includes the perception of the participant(s) (Leedy & Ormrod, 1997).

Cases should be selected purposefully to provide in-depth and rich information directed to the purpose of the study and follow a theory-based, operational, or theoretical sampling strategy (Patton, 2001). According to Patton, the main idea is to select cases according to a conceptually oriented criterion based on their representation of important theoretical constructs. Leedy explains that case

study researchers typically spend an extended period of time on-site with their research participants where they gather substantial amount of data from a wide variety of sources to present a description of the phenomenon or experience from the perspective of the participants. Thus, the fieldwork is typically a part of the data collection because it enables the researcher to engage in informal conversations with the participants and to observe and understand the phenomenon as it is experienced by them. Data is often collected by different tools and from different sources and some case study researchers also collect quantitative data (Leedy & Ormrod, 1997).

Whereas some researchers focus on the study of one case, others study multiple cases to make comparisons, build theory, and/or propose generalizations (Leedy & Ormrod, 1997). Three generic approaches may be taken to the question of who or what will be studied: first, a single focus case (the intrinsic case study), secondly, a number of cases (the collective case approach), and thirdly, multiple instances of a process as the process is displayed in a variety of different cases (Denzin & Lincoln, 1998). For the purpose of this study, three cases (neighborhoods) were selected to represent variations in neighborhood design approaches.

3.3 Criteria for the Selection of Neighborhoods

The criteria for the selection of neighborhoods were based on profiling the variability of physical attributes in two steps: the selection of different philosophical design orientations and the selection of best-fit of suburban neighborhoods.

3.3.1 Neighborhood Design Orientations

The first step in the selection of research units was to identify different philosophical neighborhood design orientations of interest in the design and planning literature as it relates to sedentary lifestyles:

1. A *traditional* type of a suburban neighborhood is typically an all-residential development that is comprehensively planned and constructed by developers. The late twentieth century style refers to low-density, detached, suburban development that are usually characterized by curvilinear streets, cul-de-sacs, low population and spatial density, wide setbacks, single-family detached houses, and large front and back yards. Most such neighborhoods can only be reached by a private automobile from collector roads.

2. A *mixed-use* type of a suburban neighborhood sometimes referred to as a ‘new urbanism community’, ‘neo-traditional community’, ‘transit-oriented development (TOD)’ or a ‘traditional neighborhood development’ (TND) in the U.S. and an ‘urban village’ in the U.K. (Katz, 1994; Schwanke, 2003; The Congress for the New Urbanism, 2005). It is typically described as a mix of residential and commercial land use. It has a mix of residential units: single family houses, townhouses and apartment complexes, along with a higher residential and spatial density. The private lots are usually smaller than in “traditional” neighborhoods, and more attention is paid to infrastructure that encourages walking, such as narrower streets with sidewalks, increased emphasis on pedestrian safety, street aesthetics, and public parks and playgrounds within a walkable distance from the place of residence.
3. A *co-housing* neighborhood is established, recognizable neighborhood type defined by a collaborative housing in which residents participate in the design and operation of their neighborhood. The residents are consciously committed to living as a community. The physical design encourages both social contact and individual space. Private homes contain all the features of conventional homes, but residents also have access to common facilities such as open space, courtyards, a playground and a common house (McCamant, Durrett, & Hertzman, 1993; The Cohousing Association of the United States, 2008).

3.3.2 Selection of Best-fit Suburban Neighborhoods

The second step was to visit the planning departments in the target area (the Chapel Hill/Carrboro urban center in North Carolina) in search of best-fit types of suburban residential neighborhoods. The selection of this area was chosen based on the convenience of the geographical location and the known availability of a few mixed-use neighborhoods and one co-housing development. The selection of potential research units was based on the following criteria:

1. Profiling similarities: Proximity to an urban center, construction period, and population characteristics.
2. Profiling dissimilarities (independent variables): Morphological characteristics including geographical area (acreage), proximity to school, geographical area, number of households, variability of formal and informal outdoor settings and indoor facilities considered important to school-aged children by the research literature

Seven neighborhoods that initially met the criteria were selected for further examination: three mixed-use neighborhoods, three traditional neighborhoods, and one co-housing community. The examination was executed by exploration of GIS data, printed maps, and planning documents, but

also zoning, land development permits, neighborhood covenants, bylaws and restrictions, and neighborhood homepages if available. The best-fit sites were visited and crude on-site analysis executed. Census block group data was also explored to further examine the socio-economic characteristics.

Out of the three mixed-use cases, one was primarily geared towards middle aged or senior citizens and did not have an elementary school within the neighborhood. The second one did not have an elementary school within the neighborhood, and had no commercial or retail (still in construction) district. The third and the largest one had an elementary school within the neighborhood and a commercial and retail district. The distance from the selected mixed-use neighborhood to the urban core was used as a frame of reference in the selection of the traditional neighborhood. The children in those neighborhoods use bus transportation to and from school. The neighborhoods were similar in geographical size but two had limited planning data. The third neighborhood was at a similar distance from the urban core as the mixed-use neighborhood chosen. Although it has a connector road cutting through (resulting in two neighborhood names), it was originally planned as one neighborhood. In some aspects this may be considered a limitation. In this study, it was, however, thought to add strength to the study of the relationship between neighborhood morphology and children's mobility.

As a result, one mixed-use suburban neighborhood, one traditional on one co-housing community were selected that best fitted the criteria. Although the co-housing neighborhood was a smaller unit of analysis in terms of population it was decided to include it in the study due to interesting site variations but treat it separately. In the following section, the morphological characteristics of the three neighborhoods are discussed in more detail followed by a summary chart.

3.3.3 The Mixed-use Neighborhood

The neighborhood selected is located about 1.3 miles from the Chapel Hill/Carrboro urban center. Although it is relatively isolated from other parts of the urban center and not easily accessible for pedestrians and cyclists it is connected to the local public transportation system and has a regional bus transits stop. The neighborhood was constructed during the mid to late 1990s, and the third and last phase was being constructed during the date collection period. It is bordered by a two-lane collector thoroughfare, another residential neighborhood, and woods on two sides.

The total land area is roughly 430 acres; thereof 312 acres are within property lines, 230 acres developed land, and 82 acres open space, greenways and parkland. The average radius from the neighborhood's center to the edge of the built area is approximately 0.4 miles. The neighborhood has

1150 residential units, thereof 530 single family houses, 140 townhouses, 230 condominiums, 250 apartments, 65,000 square feet of retail space, and 140,000 square feet of office space. Lower-density residential districts are clustered around a core of higher density residential, retail, and civic uses. The landform is a combination of rolling hills and flat areas suitable for games. Two minor streams run through the neighborhood. A conservation district was created to protect streams and adjacent floodplains and wetland. Previously, the land was mainly hardwoods and farmland. The building land consisted of clear-cut but large areas of woods which were left untouched although not easily accessible. One such is adjacent to the school where a 75 acre town community park is proposed. Another is a two acre forested park with gravel paths, picnic tables, and a small cemetery surrounded by a stone wall, located in the middle of the neighborhood, and an open grassy picnic space by the creek surrounded by trees. There is also a wooded pocket park surrounded by a stone wall, a wooded park with a dirt path connecting the neighborhood to the middle school, and also three man-made lakes in the neighborhood.

The neighborhood is divided into smaller districts, each with its own character in building styles, ranging from southern colonial to side-entry Charleston. The houses are lined up close to the street with formal front yards and informal backyards. The private lots are rather small, an average of $\frac{1}{4}$ acre or less for single family houses. Private boundaries are mostly delineated by white picket fences or vegetation. High emphasis is set on “attractive” streetscape by keeping garages and service access in back alleys. Considerable attention is placed on creating special landmarks and reference points such as fences, walls, signs, bridges and intersections where housing styles change.

The design of the streets is based on a modified grid system of interconnected streets and service back alleys. There are 70 street intersections in the neighborhood and one cul-de-sac. The streets vary from one to three lanes, nine to thirteen feet wide, some with planting stripes, some with parking lanes, and most with sidewalks on both sides. Emphasis is placed on pedestrian safety, such as sidewalks on both sides of most of the streets, crosswalks, and speed control measures. The street hierarchy and width of the streets signals a variable speed limit.

A ten foot wide, 1.3 mile long, greenway runs through the forested area along the creek and connects the south and north part of the neighborhood. The north-most end of the greenway will at a later point connect to a city-wide trail. Several informal pedestrian and bike trails exist in the woods around the neighborhood. One connects the neighborhood to the middle school, others are nature trails formed by pedestrian use.

Many activities of daily living are within walking distance, allowing independence to those who do not drive especially the elderly and the young. Formal outdoor settings such as small parks

and playgrounds are distributed throughout the neighborhood and are accessible by sidewalks and greenways. In the center of the “commercial district” is a village green with an amphitheater for festivals and outdoor movies. Sport and recreational facilities are by the club house in the center of the neighborhood, which is privately owned and has an outdoor swimming pool and tennis courts. In the commercial district there are also stores, a movie theater, restaurants and a neighborhood café. There are also several civic services in the neighborhood, such as day-care centers, churches, and a public elementary school, within walking distance for all physically able children. The main features in the school yard are manufactured play equipment, games areas, and a fenced off educational garden. A middle school is also within walkable distance.



Figure 4: An aerial view of the “mixed-use” neighborhood (scale 1:2000ft)

3.3.4 The Traditional Neighborhood

The traditional neighborhood was developed during the late 1990’s. Although it is located only about 2 miles from the Chapel Hill/Carrboro urban center, the development is not continuous and therefore

not easily accessible for pedestrians and cyclists. The neighborhood is, however, linked to a hiking trail that connects to a network of citywide recreational trails.

The total land area is about 200 acres, thereof 97 acres are developed. The average radius from the center of the neighborhood to the edge of the built area is about 0.3 miles. The neighborhood is off of a two-lane collector thoroughfare and the entrance into the neighborhood is off a two-lane collector road, which dissects the neighborhood into two parts, although originally planned as one. It is relatively isolated from other neighborhoods, schools, and commercial and retail centers, and there are no nearby accessible formal open spaces such as recreational or sport facilities.

The neighborhood is built into mature hardwoods with many interesting features. A creek runs south of the neighborhood creating many trails and play areas. The site is rather hilly and lacks flat public open space for games. The neighborhood is bordered by low traffic railroad tracks, two collector roads, hardwoods, and an airport (w/woodland strip buffer). No public transportation exists in or in the vicinity of the neighborhood.

The neighborhood has a curvilinear street layout, mostly parallel to contour lines, and two circular main roads designed as the main neighborhood streets. There are 18 street intersections in the neighborhood (mostly at the entrance of cul-de-sacs) and 20 cul-de-sacs; fourteen in one section, two off of the collector road, and four in the other parts of the neighborhood. The cul-de-sacs are not designed for play. There are sidewalks on one side of the circular streets but none in the cul-de-sacs. Little emphasis is placed on streetscape which is homogeneous and limited to automobile usage. The streets are wide and have no speed control measures i.e. not safe for children's use. Informal trails in woods within the neighborhood and in the woods beyond, along with railroad tracks, are used as pedestrian paths.

There are 206 single family houses in the neighborhood, 156 in one part and 50 in the other. The overall planning and architecture is rather homogeneous – mostly two story houses painted in earth tones. The houses are built on wooded lots and usually do not have clear boundaries i.e. little use of fences or other visual elements. The average lot size ranges from $\frac{1}{2}$ to $\frac{3}{4}$ of an acre. They are mostly are wooded with more formal front yards and less formal back yards.

There are no special landmarks or architectural features that assist in way-finding. Mailboxes are centrally located and create opportunities for informal socialization. The neighborhood does not have many public settings. There are two small formal play areas in wooded areas, which are not visible from houses and roads. There are no public indoor facilities, such as sports and recreational facilities, in or within a walkable distance from the neighborhood. The public elementary school is about 1.3 miles walking distance from the neighborhood and 1.7 miles driving distance. No formal

paths connect the neighborhood to the school and the children use the school bus. Also, there are no commercial or retail facilities within a walkable distance.

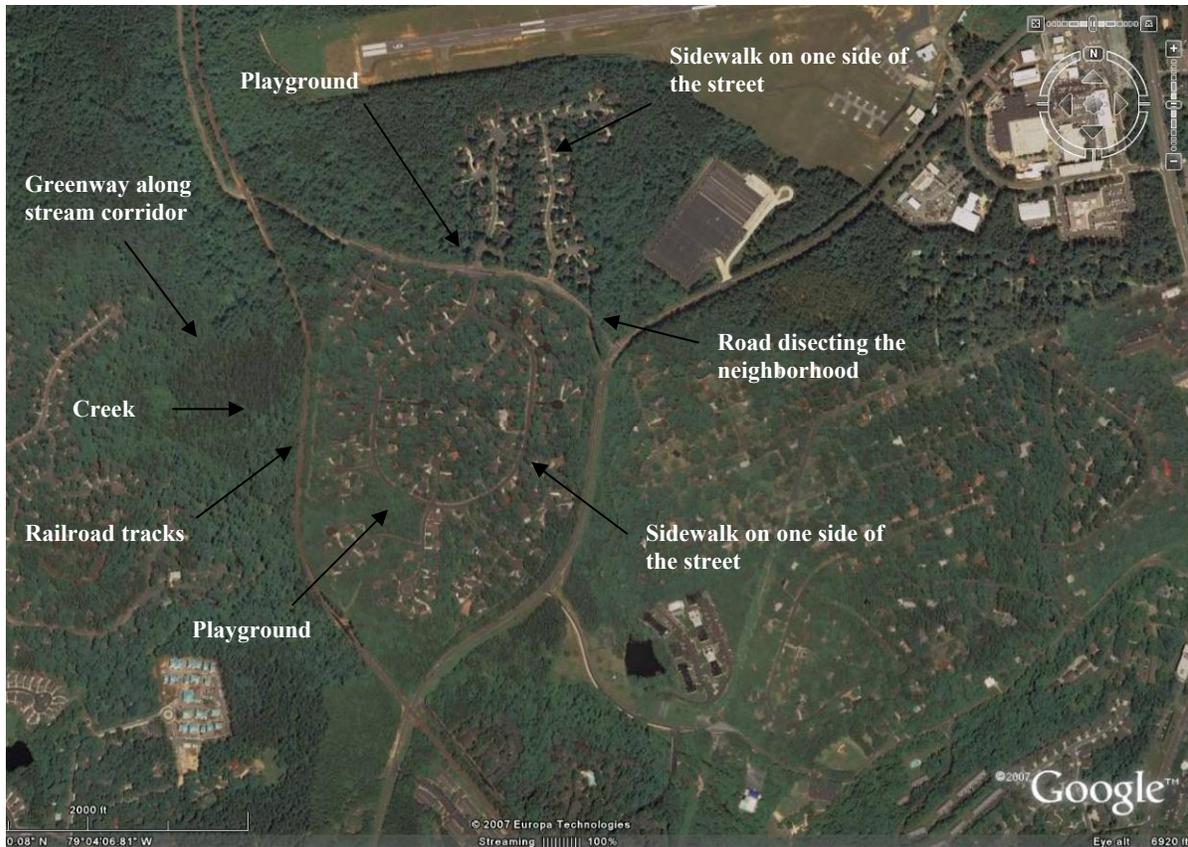


Figure 5: An aerial view of the “traditional” neighborhood (scale 1:2000ft)

3.3.5 The Co-housing Neighborhood

The co-housing neighborhood in this study is located about 2.3 miles from the Chapel Hill/Carrboro urban center. It was built during the late 1990s. The total land area is about 16 acres; thereof about 5 acres are developed. The average radius from the center of the neighborhood to the edge of the built area is about 0.1 mile.

The neighborhood has one entrance which is off of a two lane collector road. It is rather isolated from other nearby neighborhoods and other part of the city, and isolated from commercial and retail centers, and recreational and sport facilities, and is relatively disconnected to adjacent neighborhoods by borders of hardwoods and vegetation buffers. It is not easily accessible for pedestrians and cyclists and cut off from the down town area. The neighborhood is not connected to

public settings outside the neighborhood, or to adjacent neighborhoods, and there are no nearby formal public open spaces except for the school grounds, which are not easily accessible. There is no public transportation in or in the vicinity of the neighborhood.

There are 33 single family units, both detached and town homes, and one community center. The architecture is rather diverse and unique. The houses are densely clustered around a public open space, free from car traffic. Average lot size: $\frac{1}{4}$ of an acre or less, mostly wooded with more formal front yards and less formal back yards.

The neighborhood is built into a wooded landscape. The neighborhood's boundaries are defined by an access-road, woods, and an extensive area of fenced off farmland. The inner boundaries, i.e. boundaries between private property and communal spaces, are well defined and landscaped. The paved path offers an effective inner pedestrian system connecting a number of settings. There are also a number of other less formal pedestrian and bike paths, for instance a small trail leading from the neighborhood through the woods to the school. All traffic and parking is on the out-facing side of the neighborhood. The access lane to the neighborhood is moderately sloped, but the neighborhood is rather flat. The access street into the neighborhood loops in a semi circle around the neighborhood. Off of this there is private parking. There are no cul-de-sacs or back-alleys, and in general there is a high emphasis on children's safety within the neighborhood. Houses are lined up to form a large communal open space at the center, and automobile traffic is excluded from this area.

A creek and pond provide interesting areas for play, and wooded areas offer informal trails to explore. A small stream runs through the woods along the neighborhood boundaries into a pond on the edge of the community. There are no specific conservation areas but many interesting natural features in the woods, along the nearby stream, and by the pond. The neighborhood offers a variety of attractive features: the communal inner space and the communal gardening spaces, along with the pond area serve as significant landmarks. The nearness of private property and personalization, as well as noteworthy and varied architecture, also generates distinct landmarks within the community. The spatial layout is visually stimulating, varied, accessible and legible. Although the neighborhood is small in size, there are many enticing pedestrian nodes – providing visual interest at crossings and spatial intersections.

There are no actual public spaces, but high emphasis is placed on communal or shared spaces at the heart of the neighborhood. Central to it is a park-like area with paths that connect a variety of settings, such as a small “formal” playground in a shaded space. Mailboxes are centrally located and create opportunities for interaction. The only public indoor facility in the neighborhood is the community center which has a kitchen and a play room. The public elementary school is about half a

mile outside the neighborhood. There are no sports or recreational facilities, or commercial or retail facilities in the vicinity of the neighborhood, except for school grounds that are within a walkable distance.

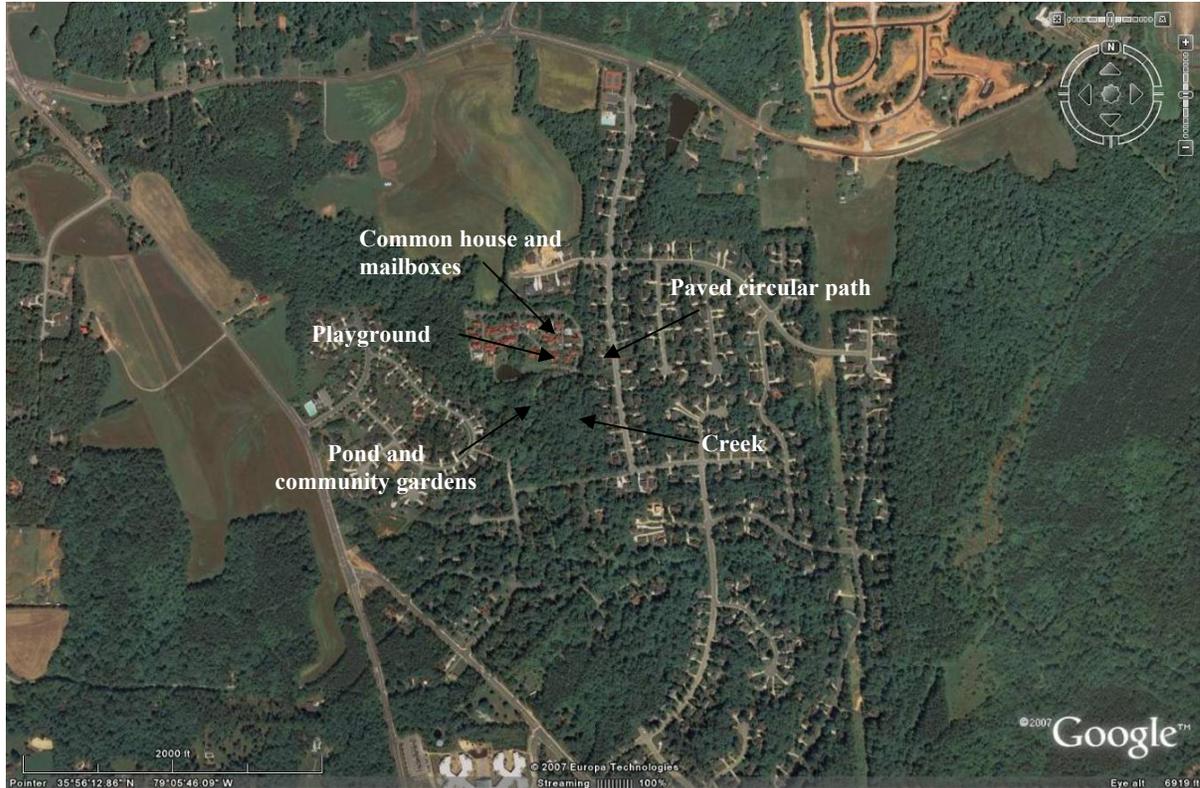


Figure 6: An aerial view of the co-housing neighborhood (scale 1:2000ft)

3.3.6 Summary of the Site Analysis for the three Neighborhoods

Table 1: Summary of the site analysis for the three neighborhoods

PROFILING SIMILARITIES			
Type	Mixed-use	Traditional	Co-housing
Proximity to urban center (fly crow)	- 1.3 miles.	- 2.0 miles.	- 2.3 miles.
Construction period	- Late 90's and early 00's.	- Late 90's.	- Late 90's.

Table 1 (continued)

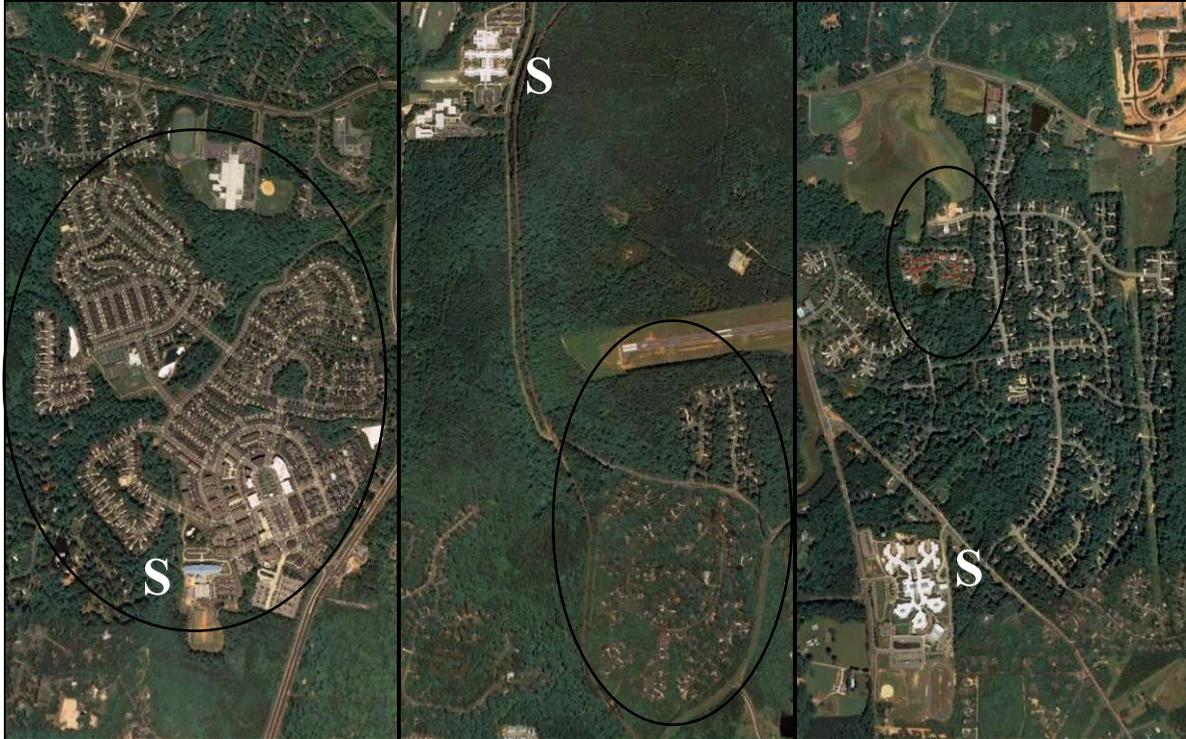
Real estate values (Census data does not exist. Therefore real estate advertisements were collected in winter 2001)	- Single family homes for sale for \$250,000 (town homes) up to \$800,000 or \$150-200 per square feet	- Single family homes for sale for around \$360,000 or \$100 per square feet.	- Single family homes for sale for around \$250-300,000 or \$150 per square feet.
Population (U.S. Census Bureau, 2000)	- Total population: 1746 - 46% male, 54% female - Children aged 5-14: 281 (16%) - Boys aged 5-14: 136 - Girls aged 5-14: 145 - Ethnic mix: 89% white, 2% black, 7% Asian, 2% other - 742 households - Family households: 436 - Average household size 2.4 - Average family size 3.0	- Total population 1023 - 48% male, 52% female - Children aged 5-14: 151 (15%) - Boys aged 5-14: 61 - Girls aged 5-14: 90 - Ethnic mix: 86% white, 7% black, 5% Asian, 2 other - 393 households - Family households 255 - Average household size 2.6 - Average family size 3.1	- Total population 386 - 47% male, 53% female - Children aged 5-14: 85 (22%) - Boys aged 5-14: 44 - Girls aged 5-14: 41 - Ethnic mix: 92% white, 1% black, 4% Asian, 3% other - 131 households - Family households 101 - Average household size 3.0 - Average family size 3.4
PROFILING MORPHOLOGICAL DISSIMILARITIES (INDEPENDENT VARIABLES)			
GEOGRAPHIC CHARACTERISTICS			
Landform, hydrology and vegetation coverage	- Varied landform with rolling hills and flat areas suitable for games	- Rather hilly landform and lacks flat public open space for games.	- The site is rather flat but lacks large open space for games.
Edges and average distance from center of neighborhood	- Bordered by a highway, residential neighborhood and woods on two sides. - Average distance from center to edge of built area is 0.4 mile.	- Bordered by woods on two sides, woods (an airport), and a collector road. - Average distance from center to edge of built area is 0.3 mile.	- Bordered by an access road, woods, and fenced off farmland. - Average distance from center to edge of built area is 0.1 mile.
Total acreage within property lines	- 616 acres.	- 96 acres.	- 14 acres.
Acreage of build land	- 270 acres (44%).	- 84 acres (88%).	- 3 acres (21%).
Acreage of open space and woodland	- 346 acres (56%).	- 12 acres (12%).	- 11 acres (79%).
Land-use	- Mixed residential, commercial, institutional, and retail	- Residential only.	- Residential only.
Residential units	- 1150 thereof 670 single family homes of detached houses and town homes.	- 206 single family detached and town homes.	- 33 single family homes of detached houses and town homes densely clustered around a public open space, free from car traffic.
Residential density	- 0.35 total acres/person	- 0.09 total acres/person	- 0.04 total acres/person
Spatial density	- 4.3 units per acre of build land	- 2.5 units per acre of build land	- 11 units per acre of build land
Neighborhood layout	- Modified grid system of interconnected streets and service back-alleys. - Most local streets are 2 traffic lanes with parking on both sides, sidewalks on both sides and a vegetation border. - 1 cul-de-sac with a large lawn area in the center. - Several back-alleys but not designed with children's play in mind.	- Curvilinear street layout, mostly parallel to contour lines. - Two circular main roads with sidewalks on one side. - 20 cul-de-sacs that are not designed for children's play - The neighborhood is off a two-lane collector road, which dissects it into two parts, although originally planned as one. - Railroad tracks are located at the edge of the neighborhood.	- The houses are lined up to form a formal, traffic free, communal open space at the center. - The neighborhood has one access street which loops in a semi circle around the neighborhood. - All traffic and parking is on the out-facing side of the neighborhood.
Connection to nearby neighborhoods	- Connected to an older neighborhood. - Three access roads	- Disconnected from nearby neighborhoods. - Two access roads	- Shares an access road with another neighborhood. - One access road

Table 1 (continued)

PRIVATE SETTINGS			
Average lot size and characteristics	<ul style="list-style-type: none"> - ¼ acre or less for single family and town homes. - Small, formal front yards and larger, less formal backyards. 	<ul style="list-style-type: none"> - ½ to ¾ acre. - Formal, large, front yards and less formal, large, mostly wooded back yards. 	<ul style="list-style-type: none"> - ¼ acre or less - More formal, small, front yards and less formal, larger, back yards.
FORMAL SETTINGS			
Public open space	<ul style="list-style-type: none"> - Clubhouse, swimming pool, and tennis courts (membership). - Basketball courts. - Large area for games. - School grounds have manufactured play equipment, games areas, and a fenced off educational garden. - Garden park divided into four areas of flowers and herbs. - A park/playground by the neighborhood café with swings, slides, and sand. - Two pocket-parks/playgrounds at the edge of wooded areas with a slide, swings and benches. - A village green with an amphitheater where outdoor movies are frequently shown during summer. Half of the village green was paved and is used for parking. 	<ul style="list-style-type: none"> - No facilities for sports within the neighborhood. - Two playgrounds are located in the woods on both sides of the neighborhood. 	<ul style="list-style-type: none"> - One small ball field within the neighborhood. - Shared community spaces on the in-facing side of the neighborhood including paved paths, community vegetable gardens, a playground, a barbeque area, and a bon-fire area.
Streets	<ul style="list-style-type: none"> - Most local streets are 2 traffic lanes with parking on both sides, sidewalks on both sides and a vegetation border. - 1 cul-de-sac with a large lawn area in the center. - Several back-alleys (not designed for children's play). - 70 street intersections (not including back-alleys) 	<ul style="list-style-type: none"> - The neighborhood is off a two-lane collector road, which dissects it into two parts, although originally planned as one. - Two circular main roads with sidewalks on one side. - 20 cul-de-sacs (not designed for children's play) - Railroad tracks are located at the edge of the neighborhood. - 16 street intersections (mostly cul-de-sacs) 	<ul style="list-style-type: none"> - The neighborhood has one access lane which loops in a semi circle around the neighborhood. - All traffic and parking is on the out-facing side of the neighborhood. - No street intersections
Formal paths	<ul style="list-style-type: none"> - Sidewalks on both sides of all streets. - Greenways (1.3 miles long) - Informal settings such as woods, access to the streams etc. are poorly accessible. 	<ul style="list-style-type: none"> - Sidewalks on one side of the two main streets. 	<ul style="list-style-type: none"> - Pedestrian area on the in-facing side of the neighborhood. - No sidewalk along the access road.

Table 1 (continued)

INFORMAL SETTINGS			
Natural areas	<ul style="list-style-type: none"> - Clear-cut for buildings but large natural areas left untouched. - 2 streams with vegetated buffers to protect streams and adjacent floodplains and wetland. - 3 man made ponds (run-off) - 75 acre woodland (future community park). - 1 forested hill park (2 acre) with gravel paths, picnic tables, and a small old cemetery. - 1 open, grassy, picnic space by the creek bordered by trees. - 2 wooded, pocket-parks. One with a dirt path connecting the neighborhood to the middle school. 	<ul style="list-style-type: none"> - The neighborhood is built into mature hardwoods. - A stream runs at the edge of the neighborhood. Vegetated buffers protect streams and adjacent floodplains and wetland. 	<ul style="list-style-type: none"> - The neighborhood is built into a wooded landscape. - A creek runs by and into a pond at the edge of the development. Vegetated buffers protect the stream and adjacent floodplains and wetland.
Informal paths	<ul style="list-style-type: none"> - Several informal trails are in the woods around the neighborhood. One connects the neighborhood to the middle school, others are nature trails formed by pedestrian use. - Informal settings such as woods, access to the streams etc. are poorly accessible. 	<ul style="list-style-type: none"> - Informal trails in the woods within the neighborhood and beyond the neighborhood. 	<ul style="list-style-type: none"> - A trail runs from the neighborhood through the woods to the access lane leading to the school. - Other smaller paths formed by pedestrian use are in the nearby woods
INDOOR FACILITIES			
Commercial, retail and institutions	<ul style="list-style-type: none"> - Movie theater, neighborhood café (ice cream), grocery store, home and garden center, book store, pizzeria, church, two daycare centers, elementary school and middle school within a walkable distance. 	<ul style="list-style-type: none"> - No commercial, institutional, and retail services within the neighborhood or within a walkable distance. 	<ul style="list-style-type: none"> - Community center - No commercial, institutional, and retail services within the neighborhood or within a walkable distance.
Distance to school	<ul style="list-style-type: none"> - Elementary school is within a walking distance for all physically able children. - Distance to school 0.1-0.9 miles. 	<ul style="list-style-type: none"> - The school is not within the neighborhood (school bus). - Distance to school 1-1.5 miles. 	<ul style="list-style-type: none"> - The school is not within the neighborhood but within a walkable distance. - Distance 0.6-0.7 miles.



Mixed-use neighborhood 0.1-1 mi Traditional neighborhood 1-1.5 mi Co-housing neighborhood 0.6-0.7 mi

Figure 7: Distance to school (Google Earth 2007 scale 1:3000ft)

3.4 Selection of the Participant Population

The criteria for the population selection (nine to eleven year old children) were based on the following three factors:

1. this age-group is considered to be the primary users of neighborhoods e.g., (Björklid, 1982; Moore, 1986; Rosenbaum, 1993),
2. during this developmental period children's home range is constantly growing– their home dwelling has become too small and step by step their neighborhood becomes their area of exploration (Nixon, 1997; Sobel, 1993), and
3. by the age of nine, children are able to orient themselves using prominent landmarks, illustrations of landmarks, aerial photographs etc. to trace activities and activity settings (R. Hart, 1979; R. A. Hart & Moore, 1973; Sobel, 1993).

The goal was to include as many nine to eleven year old boys and girls in the three neighborhoods as possible. The first step in selecting the participant population was to mail a letter to the neighborhood associations in the three neighborhoods selected, to introduce the study, obtain unofficial approval to carry the research out in the neighborhoods, ask for permission to use their mailing list, and to offer to present the results at an association meeting. A mailing list with children's names and ages, addresses and phone numbers was obtained from the neighborhood association in the "traditional" neighborhood. In the "mixed-use" community the neighborhood association would not permit the use of a neighborhood mailing list. Instead, a public list of students from the elementary school's handbook was used. The list did therefore not include children who attend other schools, public or private. Interested individual residents in the "co-housing neighborhood" assisted in obtaining a list of potential participants. The lists also included addresses and phone numbers. One participating parent in each neighborhood was asked to be a contact person, someone who was willing to assist in reaching possible participants, and keep a box where the participants would return the surveys. It was hoped that by doing so a higher return rate would be achieved.

Firstly, households with third, fourth and fifth graders were identified from the lists. Secondly, contact was made with the identified households. If door-to-door contact was not successful potential participants were contacted by phone. During the first visit (or phone call) to the participating households the researcher briefly introduced the research and its importance. The permission from the neighborhood association was stressed, and the potential participants were asked if they would also be willing to participate in the research. A standardized parental questionnaire (appendix III), and parent and child consent forms (appendix II) were distributed to those who showed interest in participating. Participants were asked to drop the completed questionnaire and the signed consent forms off at a specified location in the neighborhood. In all three neighborhoods a box was placed in front of the contact person's house. A follow-up phone call was given to those not returning the questionnaire.

3.4.1 Information on Child Participant Population

As shown in table 8, the total number of third to fifth grade children in the three neighborhoods was 137: 54 third graders, 32 fourth graders, and 41 fifth graders. Grade level data was missing for ten children. There were 51 boys and 42 girls in the mixed-use neighborhood, with a distribution by grade of 36 third graders, 27 fourth graders, and 28 fifth graders. In the traditional neighborhood, there were 24 girls and 10 boys with a distribution by grade of 11 third graders, 3 fourth graders, and

12 fifth graders. In the co-housing neighborhood there were only ten children, five girls and five boys with seven in the third grade, two in the fourth, and one in the fifth. Grade level data was missing for ten children overall, two in the mixed-use neighborhood and eight in the traditional.

The ratio of third to fifth grade children per single-family homes in the neighborhoods was 1/5 in the mixed-use neighborhood, 1/6 in the traditional neighborhood, and 1/3 in the co-housing neighborhood. The mixed-use neighborhood had more than twice the number of children than the traditional neighborhood, and 14 times the number of children in the co-housing neighborhood. But the population density of children living in single family homes was two times higher in the co-housing neighborhood than in the traditional neighborhood.

Potential participants were reached using a snowball technique by going door to door with a list of names. If no one was at home, a second door-to-door attempt was made the next day. In cases where no one was at home the third attempt was made by a phone call. Of the 106 reached, 88 accepted the invitation to participate in the research, with 54 from the mixed-use neighborhood, 26 from the traditional neighborhood, and eight from the co-housing neighborhood. The return rate for the questionnaires was 56 percent: 43 percent in the mixed-use neighborhood, 79 percent in the traditional neighborhood, and six out of ten in the co-housing neighborhood. Of the participants in the parental questionnaire, 83 percent participated in the children's activity logs. All of the logs were returned.

The activity log was followed-up with a child led fieldtrip including an open ended informal interview to explore other possible contextual influences, and to obtain a more detailed picture of children's physical activities and their favorite places. Fifteen children were selected from the three neighborhoods for the field trip: four girls and four boys from the mixed-use neighborhood, three girls and two boys in the traditional, and one girl and one boy in the co-housing neighborhood.

3.4.2 Demographic Information on the Participating Households

Children's physical activities are highly variable, and are influenced by physiological, psychological, socio-economic, and environmental factors. The purpose of the standardized questionnaire was to identify the socio-economic characteristics of participating households that might be related to outdoor physical activities of children. These characteristics included parents' age, ethnicity, marital status, education, income, occupation, length of residency, and their perception of the neighborhood outdoors. The use of the terms "mother", "father", and "parent(s)" refer to the child's primary caregivers, independent of biological and marital status.

Children's Health Condition

In the parental questionnaire (n=58) parents were asked about their child's health condition that might affect the child's regular outdoor activities. As shown in table 9, 17 percent of the total child participant population reported health problems but none of those said that the health condition affected the child's ability for normal outdoor physical activities. There were no apparent differences in general health condition of children across the three neighborhoods that would have influence on the children's participation in outdoor activities.

Socio-economic Influences

In the standardized questionnaire, the parent filling out the survey was asked about his or her relationship with the child (table 10). Over 80 percent of participating parents were mothers. It is important to keep this in mind when discussing the results from questions regarding parents' physical activities with the child, since the answers reflect possible parent gender differences. Parents were also asked about their marital status, age, ethnicity, and level of education. Most of the children (91%) lived in a household where the primary care-givers were married or lived together.

Parents of participating children were predominantly Caucasian (97% of mothers and 91% of fathers) and ranged between 35 and 64 years of age. Most were highly educated with more than 90 percent of mothers and fathers holding a four-year college or professional degree or higher.

3.5 Data Collection Instruments and Procedures

3.5.1 Qualitative-Quantitative Data Collection Framework

The research approximation used is a combined qualitative-quantitative data collection framework. According to Creswell (1994) a *quantitative study* as an "inquiry process into social or human problem, based on testing a theory composed of variables, measured with numbers and analyzed with statistical procedures, in order to determine whether the predictive generalizations of the theory hold true." In contrast he defines a *qualitative study* as "inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting" (Creswell, 1994). Thus, between the two paradigms lies in their sampling logic; quantitative studies follow a large and random sampling logic that derive

from statistical probability theory whereas qualitative studies use smaller and purposefully selected samples that are thought to be information-rich for the purpose of each study.

The main reason for choosing a combined approach was to provide opportunities to investigate “context-bound” information and influences, and thus provide in-depth understanding of the environment-behavior relationships; these will add to the children-environment area of research and theory-building by helping to explain the relationships observed. Such in-depth information will also assist in developing design and policy guidelines, grounded on the application of affordances in more supportive environments for children.

The qualitative approach is perhaps best described by the extensive literature review, development of classifications systems for physical activities and physical settings, and the field approach used. The latter would include the selection and description of the units of analysis, writing field notes and taking photographs, and the method used for recruiting participants.

3.5.2 Data Collection Methods

First of all, data on physical activity among children and the settings used are scarce and the methodology is developing. Also, there are methodological differences within the fields of environmental design (largely qualitative) and public health (largely quantitative). According to Christensen and James (2000) research with children does not necessarily entail adopting different or particular methods because, like adults, children can and do participate in all research methods. What is important is that the particular methods chosen should be appropriate for the people involved in the study, its social and cultural context and the research questions being posed. Thus, “[r]esearchers’ need, therefore, not to adopt different methods *per se*, but to adopt practices which resonate with children’s own concerns and routines (Christensen & James, 2000).”

The choice of methods was primarily based on a review of research methods provided by Lynch’s *Growing Up in Cities* (1977, edited book), Moore’s *Childhood’s Domain* (1986), Bechtel’s, Marans’ and Michelson’s *Methods in Environmental and Behavioral Research* (1987, edited book), Hart’s *Children’s Participation* (1997), Graue’s and Walsh’s *Studying Children in Context* (1998), Christensen’s and James’ *Research with Children* (2000, edited book), and Chawla’s *Growing Up in an Urbanising World* (2002, edited book). David Driskell’s *Creating Better Cities with Children and Youth* (2002) also provides an excellent overview of methods appropriate in research with children and Sallis (1993) a review of methods used in physical activity research. Several methods for data collection were explored:

1. Informal (indirect) observations (hanging out) as described by Bechtel et al. (1987) and Driskell (2002).
2. Face to face interviews as described for example by Driskell (2002), Chawla (2002), Hart (1997), Mayhall (in Christensen and James, 2000), and Lynch (1977).
3. Standardized questionnaires and surveys as described for example by Bechtel et al. (1987), Driskell (2002), Hart (1997) and Scott (in Christensen and James, 2000).
4. Children's activity logs as described by Sallis (1993) and Driskell (2002) who refers to this technique as daily activity schedules.
5. GPS/GIS tracking. At the time of data collection the technology was not advanced enough to use in this study.
6. Child-led fieldtrips as described by Moore (1986) and Driskell (2002), who refers to this technique as guided tours.
7. Participant photography as described by Bechtel et al. (1987), Chawla (2002), Driskell (2002), and Hart (1997).
8. Behavior (trace) mapping as described by Driskell (2002) and child-made maps as described by Hart (1997).

The three data collection methods chosen were: *children's activity log* including *behavioral mapping* collecting data on mobility and favorite places and a *structured survey* collecting data on types of physical activities and physical settings, and 2. *child-led fieldtrips* (including informal interviews and researcher's photography) to provide a more thorough description of environment and activities and places of interest, and 3. a *standardized parental questionnaire* to collect data on the socio, economic, and personal characteristics of the participant population, provide information about children's regular physical activities, and perceptions towards neighborhood quality.

3.5.3 Testing of Instruments

A pilot test was conducted to ensure the quality of the methods used for data collection. It was administered to several colleagues and six child-parent teams in the researcher's home neighborhood. The purpose of doing the pilot study was to (i) inspect the assumptions underlying the questions, (ii) evaluate objectives, precision and relevance of the questions, (iii) make sure that the purpose and presentation was clear and simple enough for the participants, (iv) make sure that the children could easily fill out the activity log without the help of an adult, (v) measure the approximate time of execution, (vi) check for parental responses when asked if the child could join the researcher on a fieldtrip, and (vii) to formulate the leading questions in the child-led fieldtrip and probing techniques.

The pilot study was also very helpful in estimating the time spent in introducing and explaining the study, time spent making appointments with participants, time spent collecting the questionnaires and activity logs—estimating the probability of favorable reception and return rate. The participants were also asked to comment on the quality of the instruments. They did not have any problems with understanding what they were being asked to do in the questionnaire and the activity log. A few helpful suggestions on vocabulary were made. Some parents wanted to join in on the fieldtrip. Two reasons were given a) they were interested and curious about the child's whereabouts and b) they did not want to leave the child alone with the researcher.

3.5.4 Children's Nine-day Activity Log

The physical activity log (see appendix IV) is a self-administered, structured, multiple method recall survey (SAPAC) also referred to as daily activity schedules and a recommended data collection method in environment and behavior research and public health (Driskell, 2002; J.F. Sallis, Buono, Roby, Micale, & Nelson, 1993).

The data collection was limited to out-of-school, outdoor physical activities and does therefore not give a complete picture of the total activities taking place on schooldays. A total of nine days were tallied. Weekends and schooldays were tallied separately (as used in Sallis et al., 1993, 7-day recall). For schooldays data was collected Monday through Friday and the weekend data was collected over two weekends. The reason for over-sampling the weekend was based on the assumption that weekend activities are more varied. Although the main emphasis in this research was on neighborhood activities, data on out-of-neighborhood activities was simultaneously collected. This was done for the purpose of better understanding the relationship of neighborhood supportiveness of certain types of activities children are engaged in within the neighborhood or seek opportunities outside the neighborhood.

The log consists of one worksheet for each day of the study. Each sheet included two main sections: a structured survey where the participants filled in the type of neighborhood settings, both outdoor settings and indoor facilities and an aerial photograph where they marked the activity location. The first sheet was a demo.

1. *Structured survey* reporting physical activity types the children were engaged in and the activity location. Data on physical activities children seek outside the neighborhoods was also collected to further determine the impact neighborhood morphology has on children's physical activities.

2. *Behavior mapping* (systematic, self-reported, tracking technique) where the children traced the locations of activities on an aerial photograph. On the aerial photograph for the first day, the children also marked in data regarding places they have traveled to the furthest (home-range) and their favorite places.

Although it may be difficult for children to report on their own activity, and that parents' reports are prone to biases due to lack of information and/or inaccurate recall (Institute of Medicine, 2005), this method for data collection is believed to be appropriate for this age group as by the age of nine, children are able to orient themselves using prominent landmarks, illustrations of landmarks, aerial photographs etc. to trace activities and activity settings (R. Hart, 1979; R. A. Hart & Moore, 1973; Sobel, 1993). The design of the log was geared towards reducing the burden of the participant by emphasizing a child-friendly, age-appropriate design. It is assumed that a child-friendly design, including aerial photos, illustrations in color and interesting fonts will both make the study more interesting, more educational and aid in recalling activities. The design was also structured to limit the time spent filling out the information needed, i.e. no more than 5-10 minutes every night.

The activity log was delivered in person to enable the researcher to meet with the child participant and his/her parents. The researcher explained in detail how the log works. Parents were asked to guide (with minimum interference) the child in doing the log to improve the accuracy of the activity recall (duration and consistence). A pick-up time was scheduled. The log was administered simultaneously in the three neighborhoods. The purpose for doing an in-person pick-up was to fill in missing data, if any, explore other possible contextual influences, and to inquire more about choices of activities and settings.

3.5.5 Child-led Fieldtrips

Child-led fieldtrips were conducted to further investigate interesting activity-setting leads that were discovered while reviewing the activity log at the time of pick-up. The goal with the fieldtrips was to explore other possible contextual influences and to obtain a more detailed picture of children's physical activities, the settings they use, their favorite places, and their perception of their environment (R. Hart, 1979; Moore, 1986). Also, since the activity log was limited to nine days it may have left out important information about activities children frequently do, although they did not record them during the week of data collection. The field trip methodology was largely based on R.C. Moore's description in his book *Childhood's Domain* (1986). Children (Moore refers to them as 'experts') who reported rich ranges of outdoor physical activities and physical settings in the activity

log and during the log review were asked if they would like to participate in a follow-up child-led fieldtrip. A few children, who had reported conspicuously poor ranges, were also selected to investigate further how they spent their days. Parents were encouraged to come along, but respectfully “hold back”. The children were asked to show the researcher around the neighborhood and introduce their favorite places. Each fieldtrip was scheduled to take about 30-60 minutes. The researcher carried a small pocket notebook to write down key notes and carried a pocket camera to photograph important places. A thorough description of the fieldtrip was written down immediately after each fieldtrip.

3.5.6 Standardized Parental Questionnaire

Children’s types of physical activity are highly variable, and may be influenced by a multitude of factors including physiological, psychological, socio-economic, and environmental. The purpose with the standardized questionnaire (see appendix III) was mainly twofold. First, it was used as a tool to collect data on the socio-economic characteristics of the sample, and also data on personal factors that may influence the child’s ability or opportunities for outdoor activities. This was done to measure confounding control, as much as possible, unvaried data that might affect the child’s regular outdoor activities. The questionnaire was also designed to provide information about the physical environment, especially, but not limited to, parental perception towards the quality of the neighborhood outdoor environment and opportunities for children’s outdoor activities.

The questionnaire contained 69 questions in six chapters: household (10), neighborhood quality (19), and yard quality (6), child’s journey to and from school (8), child’s activities (18), and child’s health and personality characteristics (8). Many of the questions had sub-questions and the answering possibilities ranged from simple yes/no to seven level answers. Most of the questions were closed-ended; some were closed and had an open “if yes” unit; and a few were open-ended. For analysis purposes the responses were arranged as simple nominal or ordinal responses or ranked on a *Likert attitudinal scale* (Zeisel, 1981). The answering possibilities were pre-coded accordingly.

3.6 Criteria for Data Analysis

Due to the combined qualitative-quantitative nature of this study, the criteria for data analysis is build on general standards used in quantitative research (Strauss & Corbin, 1998) and guidelines relevant for qualitative work (Leedy & Ormrod, 1997; Strauss & Corbin, 1998) and included the triangulation of qualitative and quantitative data.

The focus was placed on the in-depth understanding of the relationships between children's physical activities and neighborhood settings. The assumption was made that the sample population approximates the qualities and characteristics of the general child population in similar socio-economic situations, in similar physical environments in this geographical region in the U.S. In order to establish some basis for generalization it was therefore important to a) control, as much as possible, other influential factors: physiological, psychological, and socio-economic variables, b) use well-grounded independent variables from the physical environment, and c) well-grounded dependent variables. These were developed from review of existing relevant literature in public health and design. Generalizing information on activities from group data is complicated due to the large inter-individual variability in activity habits among children (Welk et al., 2000). Therefore, the basis for overall generalization is based on environment-behavior links through theoretical "qualitative" and descriptive "quantitative" approaches.

According to Brinberg and McGrath (1985), validity depends on the goals of the research and the stage of the process (Brinberg & McGrath, 1985). Due to the complexity of the physical environment, or set of circumstances, and the problem of isolating single independent variables in environmental design research, it can be hard to control other possible influences and establish strong evidence of internal validity, to clearly show that the elements of the environment directly influenced the elements of behavior (Bechtel et al., 1987). Establishing external validity requires that the subjects and variables have been selected so that they are representative of populations at large and the results can be generalized; this is a research population to real-world population correspondence (Bechtel et al., 1987). Generalizing to a larger population is, however, not a main concern in this research. In fact it is difficult to make predictions about a larger population in environmental design research in general, due to the fact that no two real-world environments are alike and the fact that behavior is a function of the person and the environment $B=f(P,E)$ as defined in Lewin's field theory (Gifford, 1997). Based on the principles of this theory, it can be hypothesized that aspects of the physical environment can influence children's outdoor activities in the neighborhood setting. The reliability

and credibility in this study is founded in the use of multiple methods of data collection and triangulation of data (Strauss & Corbin, 1998, citing Gliner, 1994).

3.6.1 Data Analysis for Types of Children's Physical Activities

This section discusses the approach for data analysis for the first research question: *What is the relationship between neighborhood morphology and the types of outdoor, out-of-school, physical activities children engage in?*

Data on types of physical activities were collected through the structured survey in the nine-day children's activity log. In order to use the activity types as quantitative measures for environment-behavior relations, the physical activities data were coded in accordance with the classification presented in the National Association for Sport and Physical Education (NASPE) guidelines *Physical Activity for Children, a Statement of Guidelines* (Corbin & Pangrazi, 1998; Council for Physical Education for Children, 1998) and the *PA pyramid for children's activities* (Corbin & Lindsey, 1997):

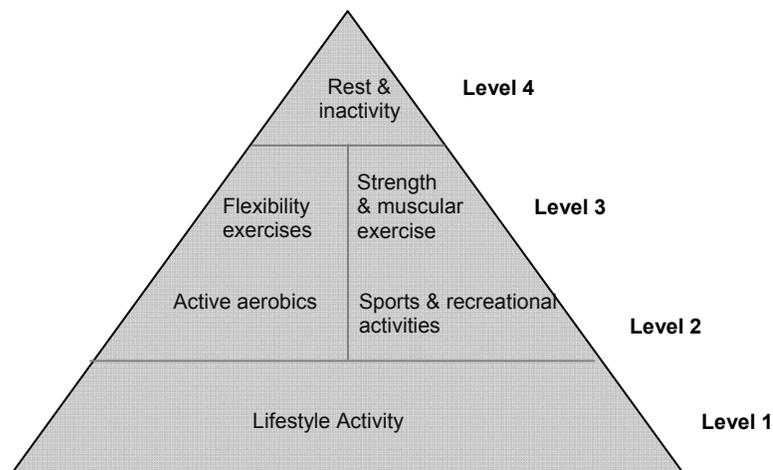


Figure 8: The physical activity pyramid adapted from Corbin and Pangrazi (1998).

In this research, the four categories were used as a foundation for classification of physical activities. For coding purposes the categories were simplified as follows:

1. *lifestyle activities,*
2. *cardiovascular activities,*
3. *flexibility and strength exercise, and*
4. *rest and inactivity.*

The sub-categories were primarily based on: (i) the compendium of physical activities for adults (Ainsworth et al., 1993) and for children and adolescents (Harrell et al., 2005), (ii) an accumulation of urban design/geography studies discussed in the literature review, and (iii) preparatory observations and informal interviews with several environment specialists and children. Additional categories were added as they appeared from the data (see appendix VI). The sub-categories were as follows:

1. lifestyle activities: *active play, domestic chores, travel between places, exploration, and nature activities,*
2. cardiovascular activities: recreation, sports (organized),
3. flexibility and strength exercise, and
4. rest and inactivity.

The complex system of physical activities made the definition of categories of activities complicated. For example, should playground activities be classified as one type of activity (active play) or as swinging, climbing, and jumping? In the case of obvious differences in the level of accuracy, an attempt was made to level the difference out by finding a common denominator that would best fit the location of the activity (the behavior setting) for example: playground activity - playground, horseback riding - riding trails, camping – campgrounds.

The data were entered into SAS-JMP statistical software and analyzed by using descriptive statistics. The analysis involved the calculation of relative frequency, percentage and mean by neighborhood and by gender. This way the associations between the independent variable and the dependent variable could be established. Although the results from the activity log were mainly explored quantitatively, they were also reviewed qualitatively by comparing the findings to the findings from the child-led fieldtrips in search for more in-depth explanations of children's activities and perceptions for cross reference purposes. This was especially important since the activity log was limited to nine days, and may have missed out settings they frequently use although they did not record them during the week of data collection.

Days children spent away from home, such as weekend at the beach or days children of parents not living together spent at "other parent's" house, were substituted by another more "regular" day or weekend to prevent skewing the data set.

The complexity of physical activities made the definition of categories of activities (and settings) complicated. For example, should playground activities be classified as one type of activity or as swinging, climbing, and jumping? In the case of obvious differences in the level of accuracy, an attempt was made to level the difference out by finding a common denominator that would best fit the

location of the activity (the behavior setting) for example: playground activity - playground, horseback riding - riding trails, camping – campgrounds.

Data on organized physical activities children seek outside the neighborhoods was also collected to further determine the impact neighborhood morphology has on children's physical activities. The data were identified by isolating from the activity log data set every record for type 2: *cardiovascular activity*. Data on children's participation in organized physical activities within and outside the neighborhood was also collected by the parental questionnaire. The data were entered into SAS-JMP statistical software and analyzed by using descriptive statistics for the calculation of relative frequency of type of activity by neighborhood and gender, within and outside the neighborhood.

3.6.2 Data Analysis for Types of Physical Settings Children Seek

This section discusses the approach for data analysis for the second research question: *What is the relationship between neighborhood morphology and the types of physical settings children seek?*

Data on types of physical settings were collected through the structured survey and behavior mapping in the nine-day children's activity log. In order to use the types of settings as quantitative measures for environment-behavior relations, the data from the structured survey were coded according to a classification of neighborhood settings (see appendix V) in which the categories were largely developed a priori, based on the review of research literature and site visits. Places that emerged from the data and were not in the list of typology were added accordingly.

Franck (1994) defines place types as conceptual categories of physical (or imaginary) places that people create, observe and experience. Places are grouped together because they are alike in some ways such as neighborhoods, parks and playgrounds; they are a part of our daily life, a form of communication, and are results of cultural evolution/selection of improvement and refinement over time. Just as the purposes values and patterns of activities and relationships change, so do types. But without repeated, recognizable kinds of places, no coordination or predictability of actions and meanings would be possible. Attributes of form, use, and meaning may be more or less loosely woven together and provides opportunities for creating new or modifying existing types (Franck, 1994).

In order to simplify the presentation of the data, the typology was limited to the following types of settings recorded:

1. *Private neighborhood settings*: child's yard, friend's yard, child's home, and friend's home.

2. *Formal neighborhood settings:*
 - a) *Open space:* parks and formal play areas, school grounds, recreation and sports fields, and swimming pools.
 - b) *Streets and formal paths (linear settings):* primary and secondary streets, tertiary streets, specific street settings, train tracks, streets good for sledding, formal paths, other, and around the neighborhood.
3. *Informal neighborhood settings:*
 - a) *Open space:* natural areas and natural areas w/ water, and other settings such as storm drains, culverts etc.
 - b) *Paths (linear settings):* informal paths.
4. *Indoor neighborhood facilities:* sport and recreation facilities, schools, retail and commercial facilities, community centers, and movie theaters.

The data were entered into SAS-JMP statistical software and analyzed by using descriptive statistics. The analysis involved the calculation of relative frequency, percentage and mean by neighborhood and by gender. This way the associations between the independent variable and the dependent variable could be established.

As with the physical activity data, the data on physical settings was also reviewed qualitatively by comparing the findings to the findings from the child-led fieldtrips in search for more in-depth explanations of children's activities and perceptions for cross reference purposes. This was especially important since the activity log was limited to nine days, and may have missed out settings they frequently use although they did not record them during the week of data collection.

Data on parents' perception of opportunities for children's outdoor activities was also collected through the standardized parental questionnaire. The data were entered into SAS-JMP statistical software and analyzed by using descriptive statistics for the calculation of relative frequency of type of activity by neighborhood and gender, within and outside the neighborhood.

3.6.3 Data Analysis for Children's Mobility

This section discusses the approach for data analysis for the third research question: *What is the relationship between neighborhood morphology and children's mobility?*

Data on children's neighborhood mobility was collected through behavior mapping in the children's activity log and the parental questionnaire. The data from the activity log were identified by isolating from the JMP data set every record for non-localized activities (type 1.3 travel between places). The determination as to whether or not an activity is non-localized was based on whether the particular activity and activity location used was the actual goal of the activity or a "byproduct." For example: "the child uses the sidewalk when walking to school". Here, the primary activity is learning

and the secondary activity is walking (non-localized activity). Similarly, the primary setting (destination) is the school and the secondary setting is the sidewalk. Thus, non-localized physical activities take place in linear settings that connect the point of origin and the point of destination. In this research the four categories for linear settings used were:

1. primary and secondary streets such as main streets, collector roads, residential streets, and through fares,
2. tertiary streets such as back-alleys, cul-de-sacs, driveways, gravel and dirt roads, eco-streets etc.,
3. formal paths such as sidewalks and greenways, and
4. informal paths, included settings such as dirt paths and nature trails.

The activity log data were entered into SAS-JMP statistical software and analyzed by using descriptive statistics. The analysis involved the calculation of relative frequency, percentage and mean by neighborhood and by gender. This way the associations between the independent variable and the dependent variable could be established. The findings from the activity log were also reviewed qualitatively by comparing the findings to the findings from the child-led fieldtrips in search for more in-depth explanations of children's activities and perceptions for cross reference purposes. This was especially important since the activity log was limited to nine days, and may have missed out settings they frequently use although they did not record them during the week of data collection.

This study also measured the distances children traveled on foot or bike within the neighborhood and the distance traveled to and from school during the five schooldays. The data on the total distance was collected by asking the children to trace the routes they traveled within the neighborhood on scaled aerial photographs in the children's activity log (behavior mapping). Due to differences in geographical area a 1:800ft scale was used for the mixed-use neighborhood and the traditional neighborhood but a 1:400ft scale for the co-housing neighborhood. For this purpose, this study used route-based technique i.e., measuring the actual route the child traveled. The distance was measured in miles per child per day. The same technique was used for measuring the distance children travel by foot or bike to and from school. The nine layers of maps for each child were compiled and simplified to show the home-range by examining the furthest points traveled to during the nine days of data collection. A fly-crow technique (the shortest possible distance measured on the map) was used to measure the distance between the child's home and the furthest point traveled to.

To further explore the importance of school walkability and the influence on children's physical activities, in the standardized questionnaire parents were asked about their child's mode of transportation to and from school and the approximate distance their child (those who do) walks to school on regular basis. The data from the questionnaire were entered into SAS-JMP statistical

software and analyzed by using descriptive statistics. The analysis involved the calculation of relative frequency and percentage by neighborhood and by gender.

Finally, data on parents' perception of children's physical and social safety was collected through the standardized parental questionnaire. The data were entered into SAS-JMP statistical software and analyzed by using descriptive statistics for the calculation of relative frequency of type of activity by neighborhood and child's gender.

3.6.4 Data Analysis for Children's Favorite Places

This section discusses the approach for data analysis for the fourth research question: *What is the relationship between neighborhood morphology and children's favorite places?*

Data on children's favorite places was collected by the children's activity log (behavior mapping) and child-led fieldtrips. During the first day of the activity log, the children were asked to mark with a green star on the aerial photograph their favorite places in the neighborhood. The child could mark as many places he or she wanted, both outdoor settings and indoor facilities. The places identified in each neighborhood were marked on a map of the neighborhood and color coded by gender.

The analysis of the qualitative field-trips data was conducted in several steps. First, the data that appeared in written field notes was written in a descriptive text for each field-trip. Then all places visited and the activities described were highlighted. The places identified were grouped according to the places typology (appendix IV). Data that were found similar in nature or related in meaning were grouped under more abstract concepts enabling the grouping of similarities under a common heading or classification for each neighborhood. Finally, a summary was written for each neighborhood. The summaries were used to look for activity patterns or themes across the neighborhoods and/or within each neighborhood. The validity of the findings was tested for plausibility by comparing them to the findings from the activity log and on-site traces and signs of use such as settings created, and equipment and tools used.

3.7 Outline of the Research Strategy

Table 2: Outline of the research strategy

Research questions	Method/instrument	Measure	Outcome
1. What is the relationship between neighborhood morphology and the types of physical activities children engage in?	<i>Structured survey</i> in the children's activity log. Type of activity was coded in accordance with the PA pyramid (Corbin and Lindsey, 1997)	Relative frequency, percentage and mean (PAs/day/child) was calculated for total activities (within and outside the neighborhood), and on schooldays and weekends.	Associations between neighborhood morphology and the types of physical activities children engage in within and across sites.
a. What is the relationship between neighborhood morphology and children's engagement in organized physical activities?	<i>Structured survey</i> in the children's activity log. <i>Parental questionnaire.</i>	Relative frequency, percentage and mean (PAs/child) was calculated for total activities within and outside the neighborhood.	Associations between neighborhood morphology and children's engagement in organized physical activities within and across sites.
2. What is the relationship between neighborhood morphology and the types of physical settings children seek?	<i>Structured survey</i> in the children's activity log. Type of setting was coded in accordance with a classification from literature review and other sources.	Relative frequency, percentage and mean (settings/day/child) was calculated for total number of settings (within and outside the neighborhood), and on schooldays and weekends.	Associations between neighborhood morphology and types of physical settings children seek within and across sites.
3. What is the relationship between neighborhood morphology and children's mobility?	<i>Structured survey</i> in the children's activity log. <i>Behavior mapping</i> in the children's activity log. <i>Parental questionnaire.</i>		Associations between neighborhood morphology and children's mobility within and across sites.
a. What types of non-localized, outdoor, out-of-school, neighborhood physical activities are children engaged in?	<i>Structured survey</i> in the children's activity log. Type of activity was coded in accordance with the PA pyramid (Corbin and Lindsey, 1997) as lifestyle activities-travel between places.	Relative frequency, percentage and mean (PAs/day/child) was calculated for total activities within the neighborhood, on schooldays and weekends.	Associations between neighborhood morphology and types of non-localized physical activities within and across sites.
b. What types of linear neighborhood settings do children seek?	<i>Behavior mapping</i> in the children's activity log tracing the routes traveled on an aerial photograph.	Relative frequency, percentage and mean (settings/day/child) for total number of settings and settings used on schooldays and weekends.	Associations between neighborhood morphology and linear settings used within and across sites.

Table 2 (continued)

<p>c. What is the total distance children travel by foot or bike within the neighborhood?</p>	<p><i>Behavior mapping</i> in the children's activity log tracing the routes traveled and the furthest points traveled to on a scaled aerial photograph.</p>	<p>Miles/day measured on a scaled aerial photograph using route-based distance.</p> <p>The distance between child's home and the furthest point traveled to during the week of data collection measured in miles (route-based) on a scaled aerial photograph in the children's activity log.</p> <p>The distance between child's home and the furthest point traveled to alone or with another child was measured in miles (fly-crow) on a scaled aerial photograph.</p>	<p>Associations between neighborhood morphology and distance traveled (home-range) within and across sites.</p>
<p>d. What is the distance children travel by foot or bike to and from school?</p>	<p><i>Behavior mapping</i> in the children's activity log tracing the routes traveled on a scaled aerial photograph.</p> <p>The distance traveled to school was also collected in the <i>parental questionnaire</i>.</p>	<p>Distance (miles/day/child) measured on a scaled aerial photograph using route-based distance.</p> <p>Distance (miles/day) on a regular basis was reported by parents.</p>	<p>Associations between neighborhood morphology (the location of school) and the distance traveled within and across sites.</p>
<p>e. What is parents' perception of children's physical and social safety?</p>	<p>The data were collected in the <i>parental questionnaire</i>.</p>	<p>Likert scale</p>	<p>Associations between neighborhood morphology and parents' perception of children's physical and social safety.</p>
<p>4. What is the relationship between neighborhood morphology and children's favorite places?</p>	<p><i>Behavior mapping</i> in the children's activity log marking the location of places on an aerial photograph.</p> <p><i>Child-led fieldtrips</i> in the neighborhood.</p>	<p>Relative frequency, percentage and mean (settings/child) was calculated for favorite places within the neighborhood.</p> <p>Notes from fieldtrips.</p>	<p>Associations between neighborhood morphology and children's favorite places within and across sites.</p>

3.8 Key Definitions

The major terms used in this research are defined as follows in an alphabetical order:

Accessibility: the level of physical access to settings that are termed important to children: distance, mobility, surface, convenience and accommodations for foot traffic, and physical and social safety.

Availability: the level of provision of particular identified settings in the physical environment. In this research the term availability is limited to settings that are accessible for the child.

Bike-able: see ‘walkability.’

Confined settings: settings that have clear visual boundaries (change in surface) such as a playground, a park, or a private yard. They are settings where localized activities typically take place

Connectivity: the level of walk-able connection between destinations (considering distance and safety).

Environmental determinants for physical activity: “modifiable factors in the physical environment that impose a direct influence on the opportunity to engage in physical activity (Penny Gordon-Larsen et al., 2000).”

Density: typically measured as population or building units per square mile.

Destination: a predetermined end of a trip, a confined setting to which someone is going to for the purpose of pursuing a particular activity.

Formal neighborhood settings: designed (built) behavior settings that are either *confined settings* such as yards, parks, playgrounds, school grounds or *linear settings* such as streets and paths.

Indicator for physical activity: “measures of the extent to which targets in health programs are being reached (WHO, 1981).”

Indoor neighborhood facilities: behavior settings for public use such as a school, stores, cafés, gyms, and movie theaters.

Informal neighborhood settings: behavior settings that have not been designed (built). They can be either *confined settings* such as fields, woods, places that collect water, and dump yards or *linear settings* such as trails and dirt bike paths.

In-neighborhood activity: as used in this research the term refers to children’s physical activity that takes place within the area provided by the aerial photograph in the children’s activity log.

Linear settings: settings that connect confined settings, points of destination, or other linear settings) such as streets and pedestrian paths. They afford non-localized access such as biking or walking to school- activities. In this research the term is used to describe a place where the purpose of the activity is not the activity in itself, but a by-product of another goal-oriented activity. Thus, the activity is not the main purpose, but a setting needed to be

able to perform another activity e.g. the child uses the sidewalk (location) to bike (by-product activity) to the ball field (destination) to play ball (goal-oriented activity).

The term is used in a similar way as Kevin Lynch (1960) defines “paths”:

“Paths are the channels along which the observer customarily, occasionally, or potentially moves. They may be streets, walkways, transit lines, canals, railroads. For many people, these are the predominant elements in their image [city image]. People observe the city while moving through it, and along these paths the other environmental elements are arranged and related”.

Localized activities: activities limited to a confined setting such as a playground or a specific element such as a swing set (see also Francis, 1985).

Location: a setting where an activity takes place. Both confined and linear settings that connect places can constitute a location.

Mobility: as used in this research the term refers to children’s traveling by foot or bike.

Neighborhood morphology: the structural (form) characteristics of the neighborhood i.e. the complete neighborhood system of localized and linear settings. In this research the term is used in a similar manner to Morris uses the term ‘urban morphology’ as a synonym for ‘urban form’ to describe the form of cities (A. E. J. Morris, 1994). The term is also often used as a synonym for ‘anatomy’ e.g., anatomy of the city.

Neighborhood: a “[d]efinable area with easily legible boundaries. It is not so large that going from one side to another requires special effort. Its physical size means that it is or can be familiar turf for everyone in it (Morris and Hess, 1975).”

Non-localized activities: activities that are a mode of getting from one place to another (e.g. biking or walking to school) and take place in linear settings that connect places such as paths and streets.

Out-of-neighborhood activity: as used in this research the term refers to children’s physical activity that takes place outside the area provided by the aerial photograph in the children’s activity log.

Physical activity: “bodily movement produced by the contraction of skeletal muscle that increases energy expenditure (US DHHS, 1996)” above the basal (resting) level. The use of this term in this research is limited to the type and frequency of physical activity

Physical setting: all settings that are inside the neighborhood property boundaries, both built and undeveloped. The definition of whether settings are in or outside the neighborhood may be

problematic especially when settings cross property boundaries such as wooded areas between neighborhoods, streets and paths.

Private neighborhood settings: homes and private yards

Suburban neighborhood: a neighborhood that is “within the metropolitan but outside of the central cities” (Department of Housing and Urban Development Policy Development and Research Information Center, 2004).

Walkability: the term is used to describe two different meanings: a) the *distance* a school-age child is capable to walk given that there are no personal hindrances and b) the *affordance* of the environment given that there are no social or physical hindrances, such as whether the environment affords walking. A clearer definition is needed for the terms “walkable” and “bike-able.” In the Nordic countries (Iceland) the rule of thumb used in urban planning is ¼ mile from homes to school and recreational facilities (Axelsson, 2007).



4 Research Findings

This chapter analyzes the data collected to provide answers to the four main research questions defining this study. Consequently, the chapter is divided into four main sections examining: (i) the types of neighborhood physical activities children engage in, (ii) the physical neighborhood settings they seek, (iii) their mobility within the neighborhood, and (iii) their most favorite places. The results are presented for each neighborhood, by gender, and across the three neighborhoods.

Sample sizes of participants varied by neighborhood, due to the difference in neighborhood size and population. There was also a difference in the participation by gender. Therefore, average numbers of activities and settings per child are used instead of total numbers. Due to the uncontrollable differences in participant population, neighborhood comparisons are limited to the mixed-use neighborhood and the traditional neighborhood.

The three methods for data collection were a standardized parental questionnaire (n=58), a nine day children's activity log (n=48), and child-led fieldtrips (n=17). A total of 1165 physical activity records were collected in the activity logs by the participating children in the three neighborhoods in 432 day records.

4.1 Children's Outdoor, Out-of-school, Physical Activities

This section examined the first research question: *What is the relationship between neighborhood morphology and types of outdoor, out-of-school, physical activities children engage in?* Special attention was also directed towards the examination of children's participation in organized physical activities. The findings are presented to address activities defined by schooldays and weekends and, where appropriate, whether they took place within or outside the neighborhood.

4.1.1 Physical Activities in the Mixed-use Neighborhood

Using a nine day activity log, the 23 children in the mixed-use neighborhood recorded a total of 619 physical activities, an average of 3.1 PAs/day. The average for the girls was 2.6 PAs/day and for the boys it was 4.0 PAs/day.

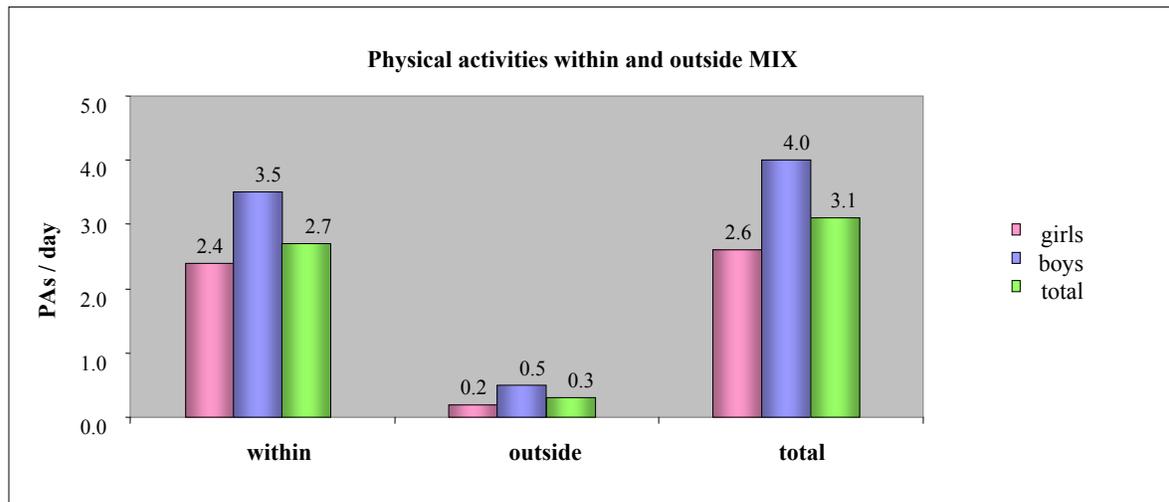


Figure 9: Physical activities within and outside the mixed-use neighborhood

As shown in table 11, only 9% of the activities during the nine days of data-collection took place outside the neighborhood, an average of 0.3 PAs/day. The boys recorded 0.3 PAs/day more out-of-neighborhood activities than the girls. As shown in table 13, the types of out-of-neighborhood activities recorded were: 46% *lifestyle activities* (all *active play*), 46% *cardiovascular activities*, and 7% *flexibility and strength exercise*. The boys recorded 14% more *cardiovascular activities* than the girls, who recorded 10% more *lifestyle activities* and 5% more *flexibility and strength exercise*.

Of the total activities, 91% were recorded within the neighborhood, an average of 2.8 PAs/day. The boys recorded 1.1 PAs/day more activities per day than the girls. The distribution by type of neighborhood activities during the nine days, as shown in table 12a, was: 98% *lifestyle activities*, 1% *cardiovascular activities*, and 1% *rest and inactivity*. Of the *lifestyle activities*, 49% were *travel between places*, 44% *active play*, 5% *domestic chores*, and 1% *nature activities*. The distribution of the main categories of activity was the same for the girls and the boys, but there was more difference in the distribution of *lifestyle activities*; the boys recorded 6% more *active play* and the girls 6% more *travel between places*.

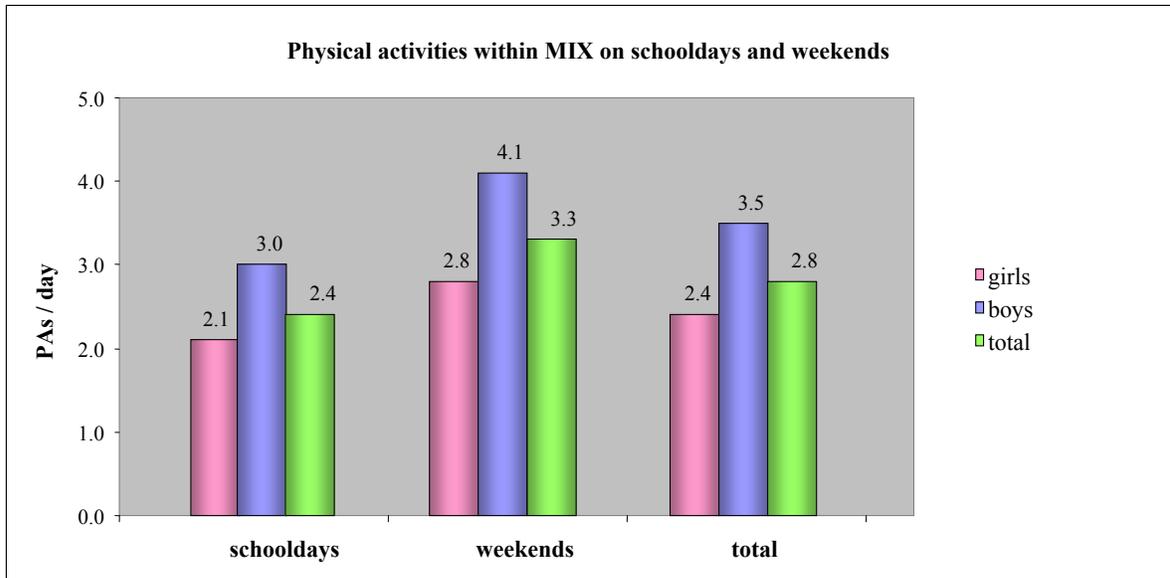


Figure 10: Physical activities within the mixed-use neighborhood on schooldays and weekends

As shown in table 12b, 49% of the neighborhood activities were recorded during the five schooldays. The average number of activities was 2.4 PAs/day; 2.1 PAs/day for the girls and 3.0 PAs/day for the boys. The distribution of types of physical activities on schooldays was: 98% *lifestyle activities*, 1% *cardiovascular activities* and 1% *rest and inactivity*. Of the *lifestyle activities*, 54% were *travel between places* and 40% *active play*. The distribution of type of activity was similar for the girls and the boys.

As shown in table 12c, 51% of the neighborhood activities were recorded during the two weekends. The average number of activities was 3.3 PAs/day; 2.8 PAs/day for the girls and 4.1 PAs/day for the boys. The distribution of types of neighborhood activities was: 99% *lifestyle activities* and 1% *rest and inactivity*. Of the *lifestyle activities*, *travel between places* and *active play* were the most common. The boys were 10% more engaged in *active play* and the girls 14% more engaged in *travel between places*.

4.1.2 Physical Activities in the Traditional Neighborhood

Using a nine day activity log, the 21 children in the traditional neighborhood recorded a total of 430 physical activities in the activity log during the nine days tallied, an average of 2.3 PAs/day. The average for the girls was 2.2 PAs/day and for the boys it was 2.4 PAs/day.

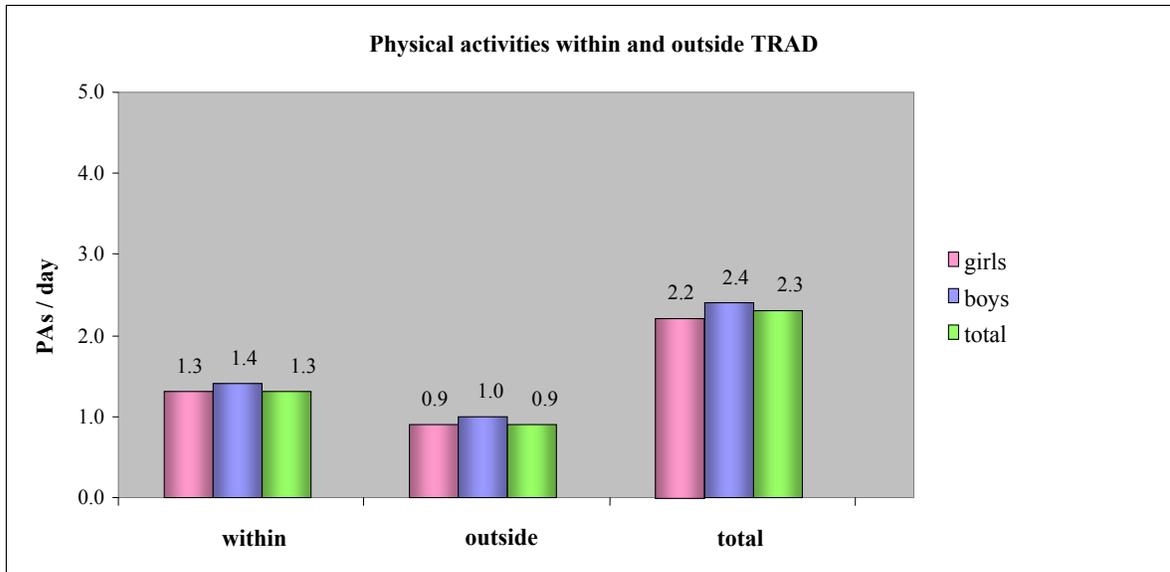


Figure 11: Physical activities within and outside the traditional neighborhood

Of the total activities, as shown in table 11, 41% were recorded outside the neighborhood, an average of 0.9 PAs/day. The average number of activities by gender was similar. The distribution of types of activities, as shown in table 13, was: 66% *lifestyle activities* (85% *active play*), 29% *cardiovascular activities*, 4% *rest and inactivity*, and 1% *flexibility and strength exercise*. The boys recorded 5% more *rest and inactivity* than the girls, who recorded 8% more *lifestyle activities*.

Of the total activities, 59% were recorded within the neighborhood, an average of 1.3 PAs/day. The average number of activities by gender was similar. All of the activities recorded during the nine days, as shown in table 12a, were *lifestyle activities*, thereof, 61% *active play*, 19% *travel between places*, 13% *domestic chores*, 7% *nature activities*, and 1% *exploration*. The boys recorded 14% more *active play* than the girls who recorded 7% more *travel between places* and 4% more *nature activities*. The distribution of *domestic chores* and *exploration* was similar.

As shown in table 12b, 56% of the neighborhood activities were recorded during the five schooldays. The average number of school-day activities was 1.4 PAs/day; 1.2 PAs/day for the girls and 1.6 PAs/day for the boys. The distribution by type of activity was: 99% *lifestyle activities* and 1% *rest and inactivity*. Of the *lifestyle activities*, 55% were *active play*, 27% *travel between places*, 11% *domestic chores*, 6% *nature activities*, and 1% *exploration*. The girls were 17% more engaged in *travel between places* than the boys, who were 7% more engaged in *active play* and 10% more engaged in *domestic chores* (10%).

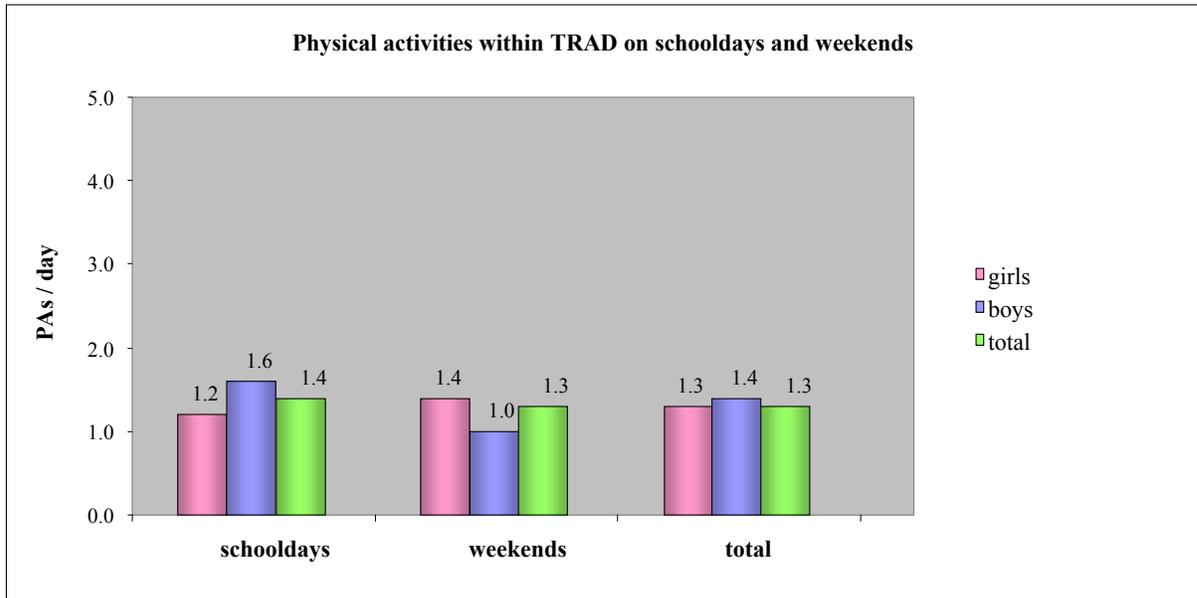


Figure 12: Physical activities in the traditional neighborhood on schooldays and weekends

As revealed in table 12c, 44% of the neighborhood activities were recorded during the two weekends. The average number was 1.3 PAs/day; 1.4 PAs/day for the girls and 1.0 PAs/day for the boys. All of the activities were *lifestyle activities*; 68% *active play*, 15% *domestic chores*, 9% *travel between places*, 7% *nature activities*, and 1% *exploration*. The boys were 31% more engaged in *active play* than the girls, who were 19% more engaged in *domestic chores* and 9% in *nature activities*.

4.1.3 Physical Activities in the Co-housing Neighborhood

Using a nine day activity log, the four children in the co-housing neighborhood recorded a total of 117 physical activities in the activity log during the nine days tallied. The average number of activities per child was 3.3 PAs/day; 1.3 PAs/day for the girl and 3.9 PAs/day for the boys.

As shown in table 11, only 13% of the total activities took place outside the neighborhood, an average of 0.4 PAs/day. All of the out-of-neighborhood activities were *lifestyle activities* (table 13).

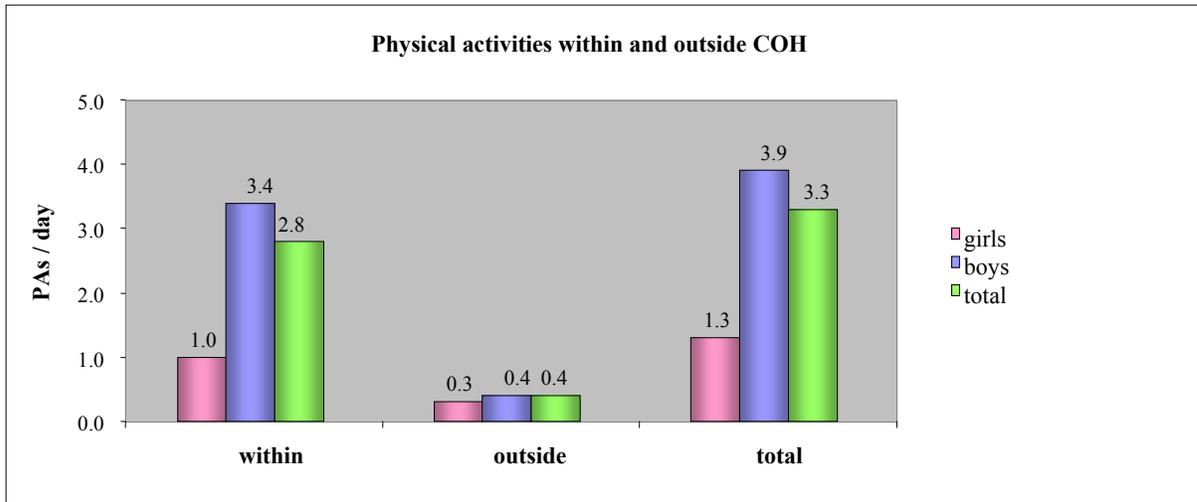


Figure 13: Physical activities within and outside the co-housing neighborhood

Of the total activities, 87% were recorded within the neighborhood. The average number of activities was 2.8 PAs/day; 1.0 PAs/day for the girl and 3.4 PAs/day for the boys. As shown in 8a, the distribution by type of activity was: 96% *lifestyle activities*, 1% *cardiovascular activities*, and 3% *rest and inactivity*. Of the *lifestyle activities*, 79% were *active play*, 9% *travel between places*, 6% *nature activities*, 4% *domestic chores*, and 1% *exploration*. The distribution of the main categories of activity was similar for the girl and the boys but there was more difference in the distribution of *lifestyle activities*, especially *active play* and *travel between places*.

As shown in table 12b, 59% of the neighborhood activities were recorded on schooldays. The average number of activities was 3.0 PAs/day; 1.0 PAs/day for the girl and 3.7 PAs/day for the boys. The distribution of neighborhood activities on schooldays was: 98% *lifestyle activities* and 2% *cardiovascular activities*. The internal distribution of *lifestyle activities* was 76% *active play*, 10% *travel between places*, 8% *nature activities*, 3% *domestic chores*, and 2% *exploration*. There was little gender difference in the main categories but in the distribution of types of *lifestyle activities*, the girl recorded 11% more *travel between places* than the boys, who recorded 18% more *active play*.

As shown in table 12c, 41% of the total activities were recorded during the two weekends. The average number was 2.6 PAs/day; 1.0 PAs/day for the girl and 3.2 PAs/day for the boys. The distribution by type of activity was: 93% *lifestyle activities* and 7% *rest and inactivity*. Of the *lifestyle activities*, 82% were *active play*, 8% *travel between places*, 5% *domestic chores*, 3% *exploration* and 3% *nature activities*. For the *lifestyle activities*, the boys were more engaged in *active play* and the girl in *travel between places* and *nature activities*.

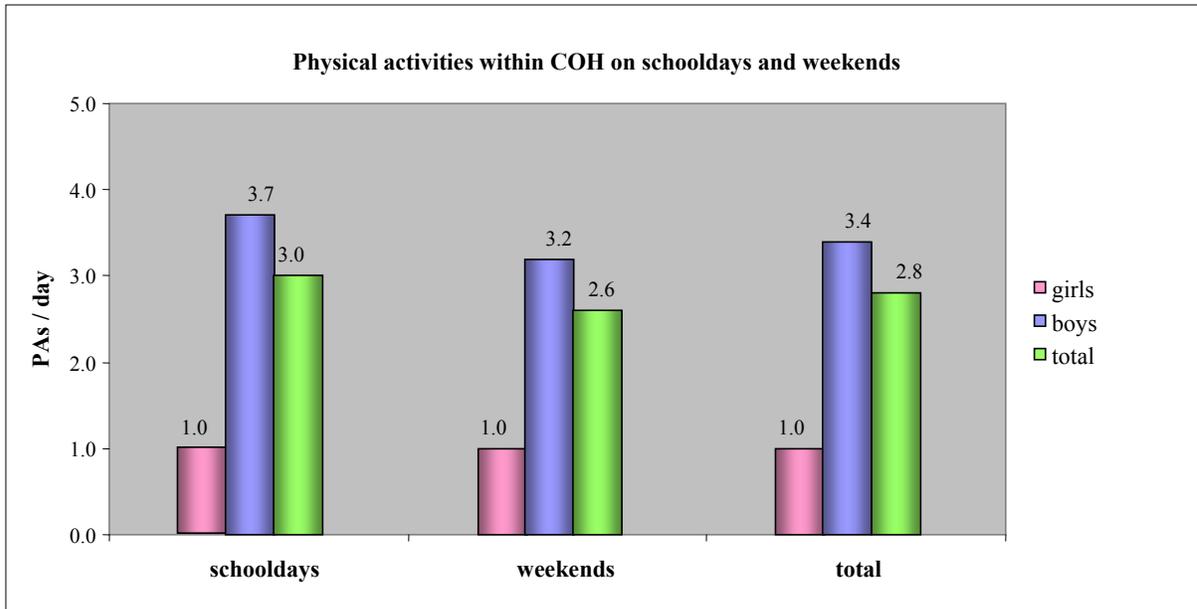


Figure 14: Physical activities in the co-housing neighborhood on schooldays and weekends

4.1.4 Comparing Physical Activities in the Three Neighborhoods

Total Physical Activities within and outside the Neighborhoods

As shown in table 11, the children in the mixed-use neighborhood were engaged in 0.8 PAs/day more total activities during the nine days than those in the traditional neighborhood. The children in the co-housing community recorded 0.2 more PAs/day than those in the mixed-use neighborhood and 1.0 more PAs/day than those in the traditional locality.

The children in the mixed-use and co-housing communities were engaged in 1.4-1.5 more PAs/day within their neighborhoods than the children in the traditional, who, on the other hand, were engaged in 0.5-0.6 more out-of-neighborhood PAs/day.

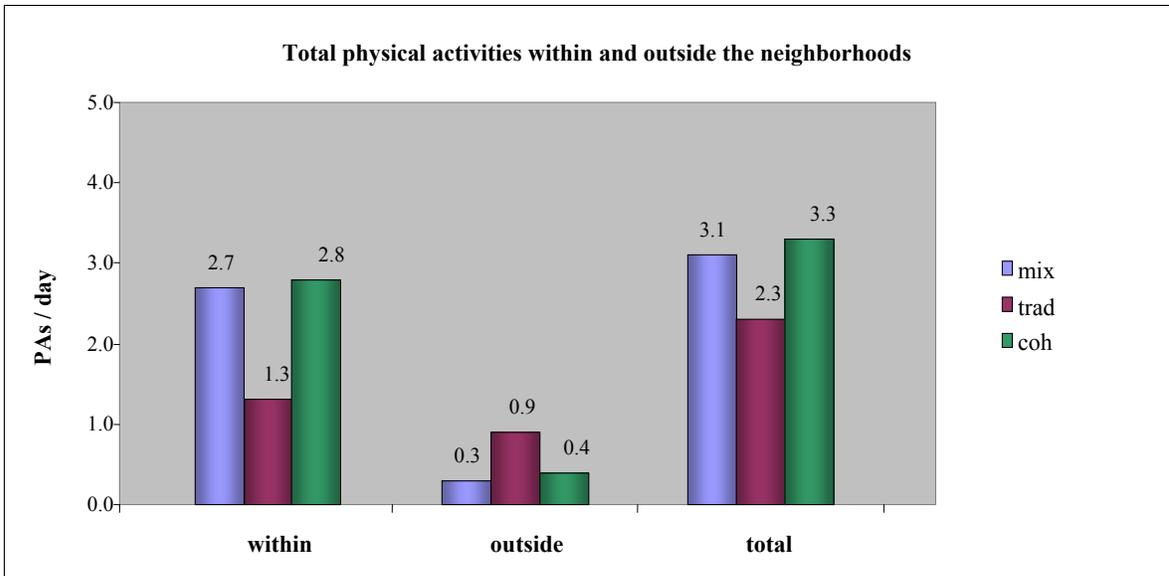


Figure 15: Total physical activities within and outside the neighborhoods

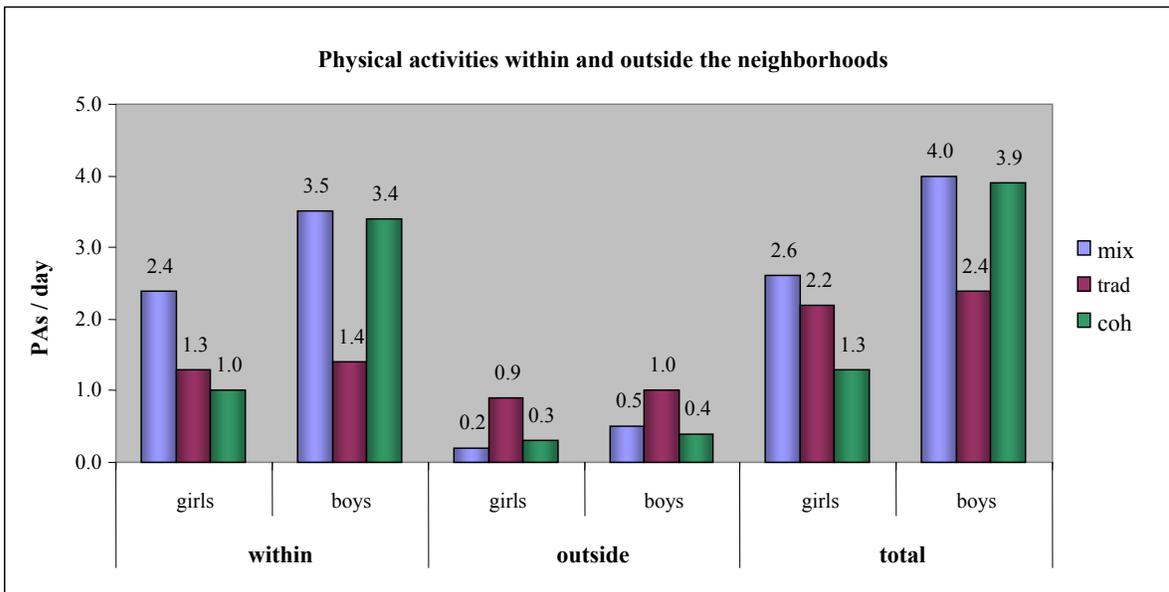


Figure 16: Physical activities within and outside the neighborhoods

The boys in all three sample areas recorded more activities within and outside the neighborhoods. This gender difference was less pronounced in the traditional neighborhood. When comparing the genders across the neighborhoods, the girls in the mixed-use category recorded 1.1 PAs/day more

activities within the neighborhood than those in the traditional category, who recorded 0.7 PAs/day more activities outside the neighborhood. Likewise, the boys in the mixed-use and co-housing neighborhoods recorded 2.1 PAs/day more neighborhood activities than those in the traditional category, who recorded 0.5 PAs/day more out-of-neighborhood activities.

Types of Physical Activities within the Neighborhoods

Of activities within all three neighborhoods, as shown in table 12a, *lifestyle activities* accounted for 96-100%. The internal distribution of types of *lifestyle activities* differed however somewhat.

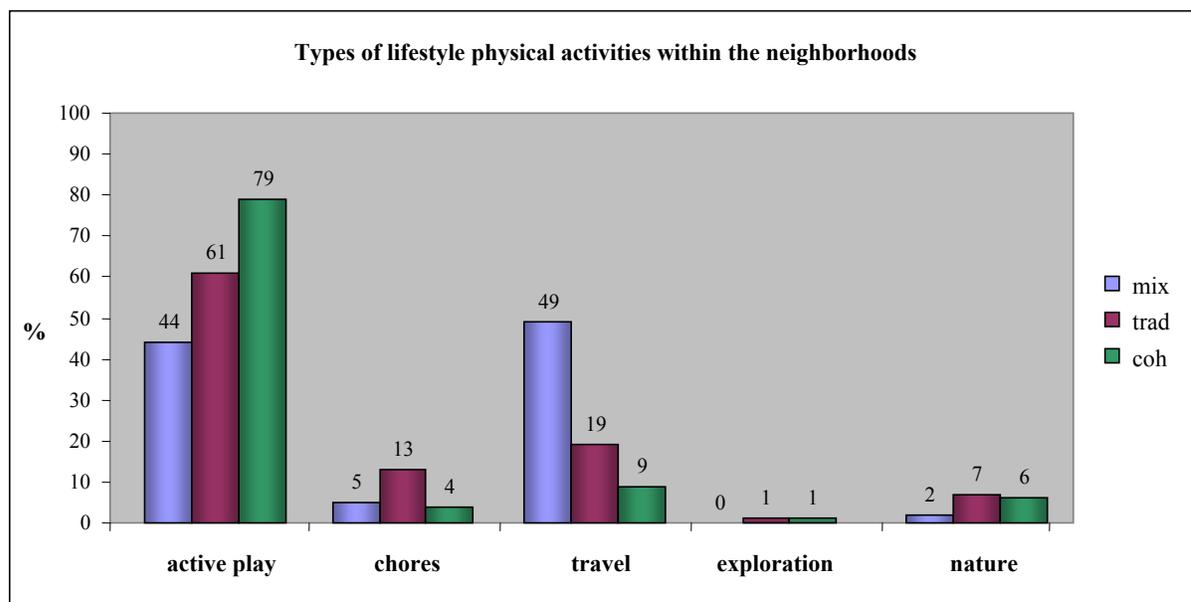


Figure 17: Types of lifestyle physical activities within the neighborhoods

The children in the traditional neighborhood recorded 17% more active play than those in the mixed-use neighborhood and the children in the co-housing community recorded 18% more *active play* than those in the traditional and 35% more than those in the mixed-use neighborhood. The children in the mixed-use neighborhood recorded, on the other hand, 30% more *travel between places* than those in the traditional neighborhood and 40% more than those in the co-housing community. The children in the traditional neighborhood recorded 8-9% more *domestic chores* than those in the mixed-use and co-housing localities. Finally, the children in the traditional and the co-housing neighborhoods recorded 5-6% more *nature activities* than those in the mixed-use neighborhood. *Exploration* was rarely recorded in any of the three communities.

Types of Physical Activities within the Neighborhoods on Schooldays

As revealed in table 12b, the children in the mixed use neighborhood recorded 1.0 PAs/day more neighborhood activities on schooldays than those in the traditional development. The children in the co-housing community recorded, on the other hand, 0.6 PAs/day more activities than those in the mixed-use and 1.6 PAs/day more than those in the traditional neighborhood.

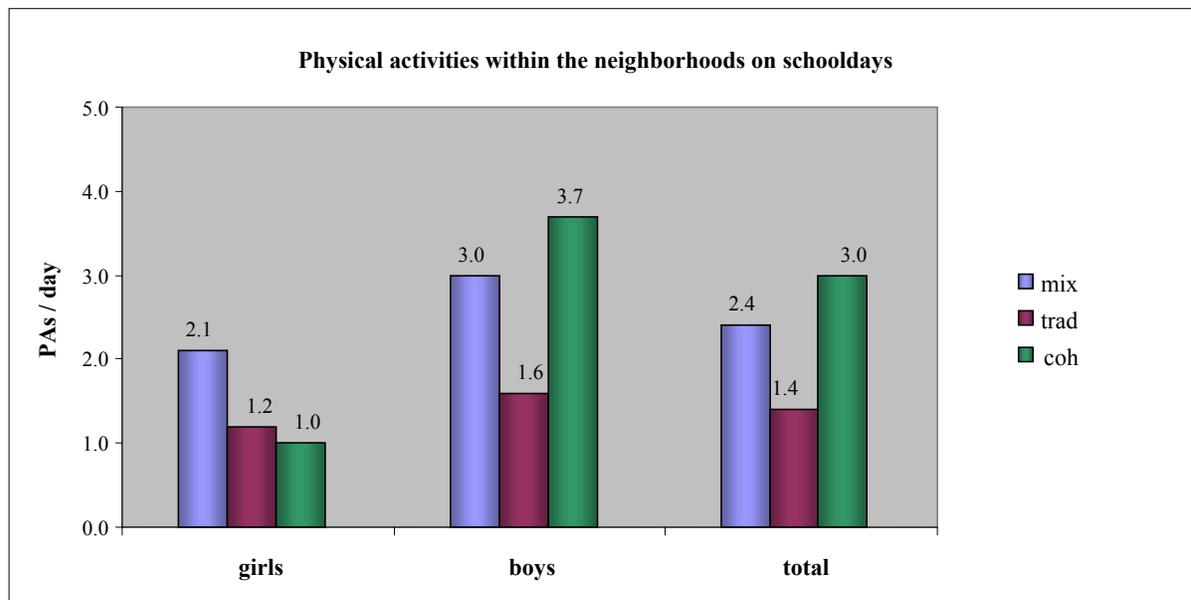


Figure 18: Physical activities within the neighborhoods on schooldays

The distribution by gender differed somewhat. The boys in all three neighborhoods recorded more PAs/day than the girls: 0.9 in the mixed-use, 0.4 in the traditional, and 2.7 in the co-housing neighborhood. When comparing the genders across the neighborhoods, the girls in the mixed-use neighborhood recorded 0.9 PAs/day more activities than those in the traditional. The boys in the mixed-use neighborhood recorded 1.4 PAs/day more than the boys in the traditional but 0.7 PAs/day less than those in the co-housing community.

Although most of the neighborhood activities on schooldays in the three neighborhoods were *lifestyle activities* (98-99%), there was a difference in the distribution within this type of activity.

The greatest differences were that the children in the traditional neighborhood recorded 15% more *active play* and 7% more domestic chores than those in the mixed-use neighborhood. The children in the mixed-use neighborhood were, on the other hand, 27% more engaged in *travel between places* than those in the traditional neighborhood and 44% more than those in the co-housing

community. Of the activities reported in the co-housing community, $\frac{3}{4}$ were *active play* which is more than in the other two neighborhoods. They were also 2-7% more engaged in *nature activities*. Neighborhood *exploration* only accounted for 1-2% of the activities in all three neighborhoods.

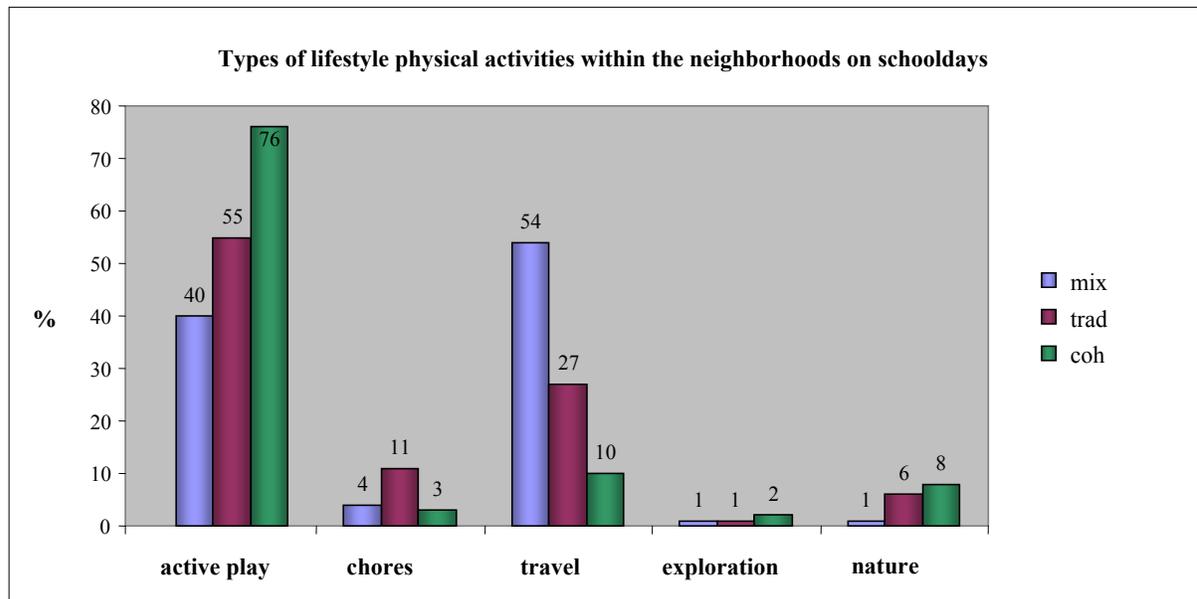


Figure 19: Types of lifestyle physical activities within the neighborhoods on schooldays

In terms of types of *lifestyle activities* by gender, the distribution in the mixed-use neighborhood was similar. In the traditional neighborhood, the boys were 7% more engaged in *active play* and 10% more in *domestic chores*, but the girls were 17% more engaged in *travel between places*.

Types of Physical Activities within the Neighborhoods on Weekends

On weekends, as shown in table 12c, the children in the mixed-use neighborhood recorded 2.0 PAs/day more neighborhood activities than those in the traditional neighborhood and 0.7 PAs/day more than those in the co-housing community.

The distribution of neighborhood activities over weekends by gender was somewhat different. The boys in the mixed-use recorded 1.3 PAs/day more activities than the girls but the girls in the traditional neighborhood recorded 0.4 PAs/day more activities than the boys. When comparing the genders across the neighborhoods, the girls in the mixed-use neighborhood recorded 1.4 PAs/day more than those in the traditional. The boys in the mixed-use neighborhood recorded 3.1 PAs/day

more than the boys in the traditional neighborhood and 0.9 PAs/day more than those in the co-housing community.

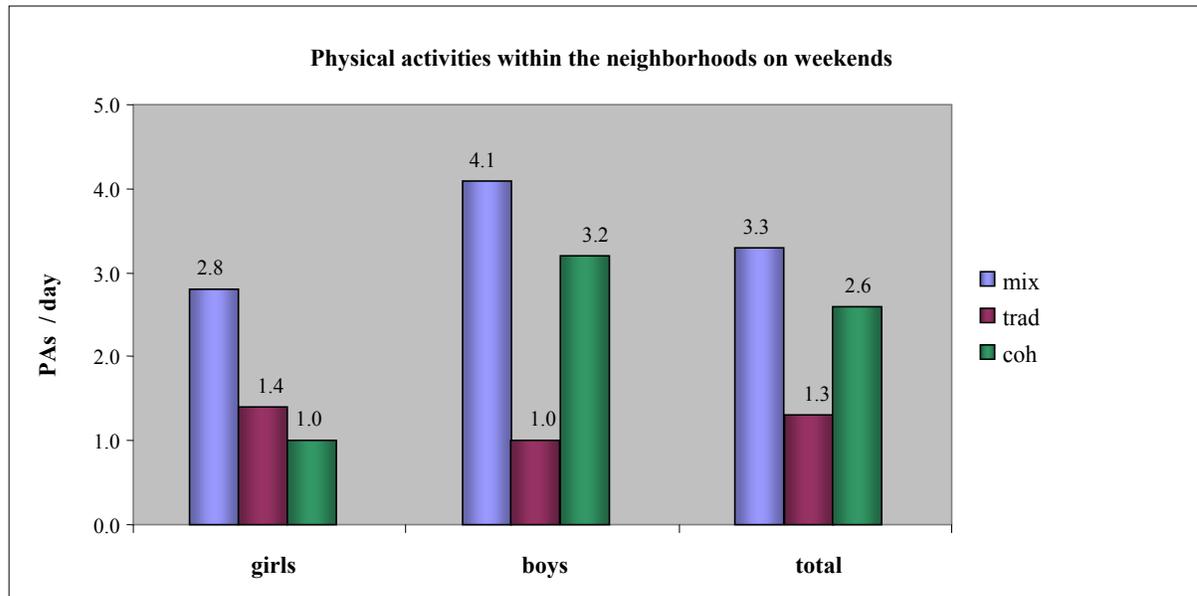


Figure 20: Physical activities within the neighborhoods on weekends

Although most of the neighborhood activities on weekends in the three neighborhoods were *lifestyle activities* (93-100%) there was a difference in the neighborhood distribution within this type of activity.

Comparing the children in the mixed-use and traditional communities, those in the traditional were more engaged in *active play* (+20%), *domestic chores* (+9%), and *nature activities* (+5%). The children in the mixed-use neighborhood were, on the other hand, 35% more engaged in *travel between places*. More than 80% of the activities reported in the co-housing community were *active play* which is 14% more than in the traditional and 34% more than in the mixed-use neighborhood. Neighborhood *exploration* only counted for 0-3% of the activities in the three neighborhoods.

In terms of distribution of types of activities by gender, the distribution into main categories in the neighborhoods was similar. Looking at the distribution of types of *lifestyle activities*, the girls in the mixed-use neighborhood were 14% more engaged in *travel between places* but the boys were 10% more engaged in *active play*. In the traditional neighborhood, the girls were 19% more engaged in *domestic chores* and 9% in *nature activities* than the boys, who, were 31% more involved in *active play*.

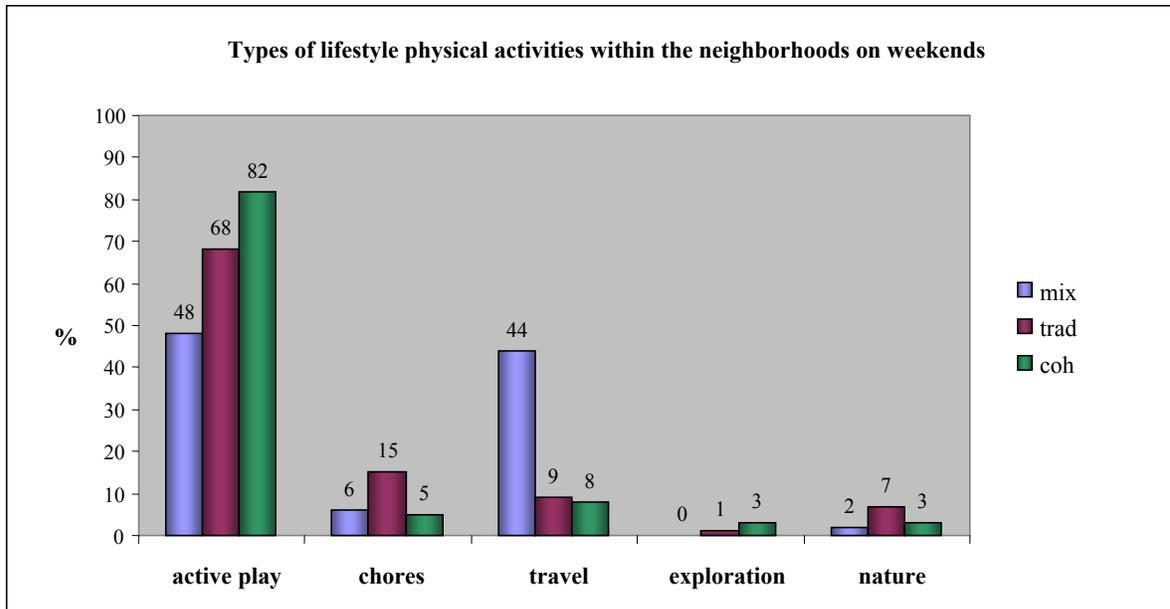


Figure 21: Types of lifestyle physical activities within the neighborhoods on weekends

Types of Physical Activities outside the Neighborhoods

Also of interest in this research was the types of physical activities children seek outside the neighborhood to further explore the relationship between physical activities and neighborhood affordances, or lack thereof. As shown in table 11, the types of out-of-neighborhood activities varied.

The most frequently recorded activities by the children in the mixed-use neighborhood were: 46% *lifestyle activities* (all *active play*) and 46% *cardiovascular activities*. The distribution in the traditional neighborhood was: 66% *lifestyle activities* (mostly *active play*) and 29% *cardiovascular activities* while the activities recorded by the children in the co-housing neighborhood were all *lifestyle activities*. There was more gender difference in the mixed-use neighborhood than in the traditional neighborhood. The girls in the mixed-use neighborhood recorded 10% more *lifestyle activities* and 5% more *flexibility and strength exercise* but the boys 14% more *cardiovascular activities*.

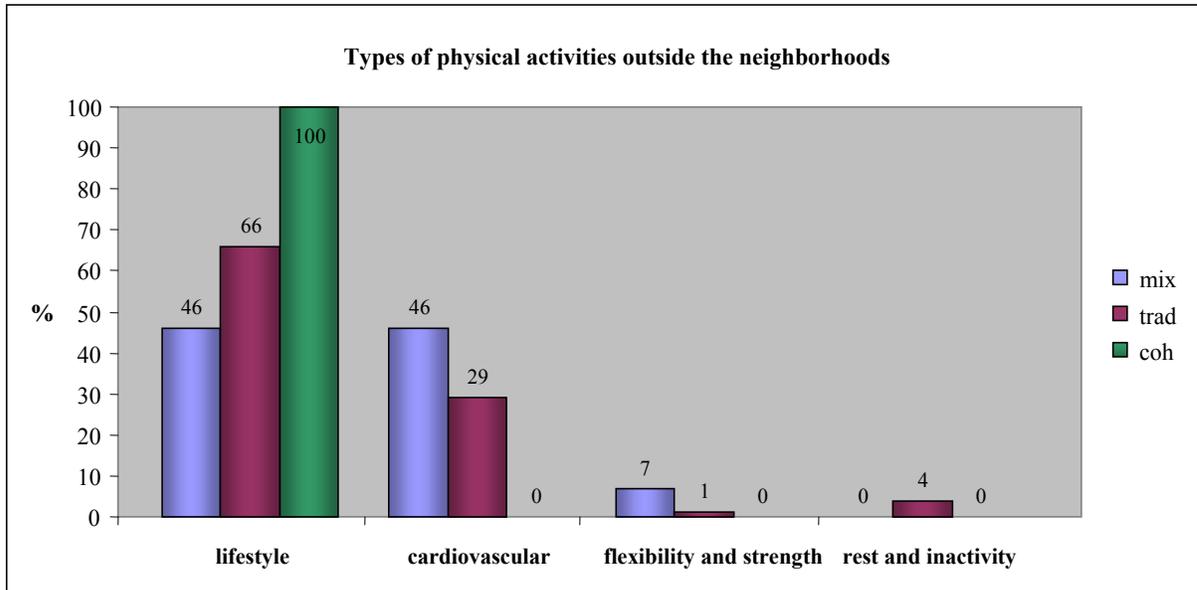


Figure 22: Types of physical activities outside the neighborhood

4.1.5 Organized Physical Activities in the Three Neighborhoods

In the parental questionnaire, 58 parents were asked about their child's participation in organized physical activities (*cardiovascular activities*). Data were collected on neighborhood and out-of-neighborhood activities.

As shown in table 14, the participation in organized activities within the neighborhood was limited to the mixed-use neighborhood (n=29), where 52% of the children were involved: 40% of girls and 78% of boys. The types of organized activities the girls were engaged in were tennis, tang soo do, swim team and girl scouts (includes some physical activities). The boys were mostly engaged in tennis, swim team, soccer and lacrosse. The average number of organized activities for the boys was 0.6 PAs/day higher for the girls.

About 70% of the total population was involved in organized out-of-neighborhood activities; 59% in the mixed-use neighborhood (n=29), 91% in the traditional (n=23), and two out of six in the co-housing community. Boys engagement over girls' was also noteworthy or 11-12% in all three neighborhoods. The most frequently reported types of organized physical activities outside the neighborhoods were: baseball/softball (23%), soccer (19%), basketball (17%), swim team (14%), and dance (9%).

4.1.6 Summary of Findings for Physical Activities

The findings from the children's activity log showed that about 90% of the total physical activities/settings in the mixed-use neighborhood and three out of four co-housing neighborhood took place within the neighborhood, but only about 60% in the traditional neighborhood. The children in the co-housing and mixed-use neighborhoods were 1.5 PAs/day more engaged in physical activities within their neighborhoods than those in the traditional neighborhood; these children, conversely, were 0.5-0.6 PAs/day more involved in physical activities outside their neighborhood.

Although almost all of the physical activities recorded within the neighborhoods were *lifestyle activities*, the distribution by types differed by neighborhood. Two of five categories were more frequently recorded: *active play* and *travel between places*. The children in the co-housing and traditional communities were 35% more engaged in *active play* than those in the mixed-use neighborhood who were 30-40% more engaged in *travel between places* than the children in the other two neighborhoods. The children in the traditional neighborhood were more engaged in *domestic chores* than those in the other two neighborhoods. *Nature activities* and especially *neighborhood exploration* were rarely mentioned in all three neighborhoods. The children in the mixed-use neighborhood were more mobile on schooldays and the participants in all three neighborhoods were more engaged in *active play* on weekends.

The boys were more engaged in physical activities within the neighborhoods than the girls, especially in the mixed-use (+1.4 PAs/day) and the co-housing (+2.6 PAs/day) neighborhoods. The girls in the mixed-use category recorded more neighborhood physical activities than those in the traditional category (+0.4 PAs/day). This difference was even greater for the boys (+1.6 PAs/day). The distribution on schooldays and weekends mostly reflects the total set, though the boys in the co-housing neighborhood recorded more activities/child on schooldays than those in the other two neighborhoods. The most notable difference on weekends was that the girls in the traditional neighborhood recorded more activities than the boys. The difference on weekends was mostly that the girls in the traditional neighborhood recorded more activities than the boys, and the boys in the mixed-use neighborhood recorded more than those in the co-housing neighborhood.

The children in the mixed-use neighborhood were the only ones participating in organized physical activities within their neighborhood or about half of the population. The boys were more involved than the girls. About 70 percent of the total child population was engaged in organized physical activities outside the neighborhoods; 59 percent in the mixed-use neighborhood, 91 percent in the traditional, and two of six in the co-housing category.

4.2 Physical Settings Children Seek within the Neighborhood

This section examined the second research question: *What is the relationship between neighborhood morphology and the types of physical settings children seek?* Since all activities take place in physical settings, the findings from previous section, in terms of total and average numbers of physical activities, also applies to this section on the types of settings used in the neighborhoods.

4.2.1 Physical Settings in the Mixed-use Neighborhood

During the nine days of the activity log, the 23 children in the mixed-use neighborhood visited 18 settings types (see sub-categories in classification of neighborhood setting in appendix V).

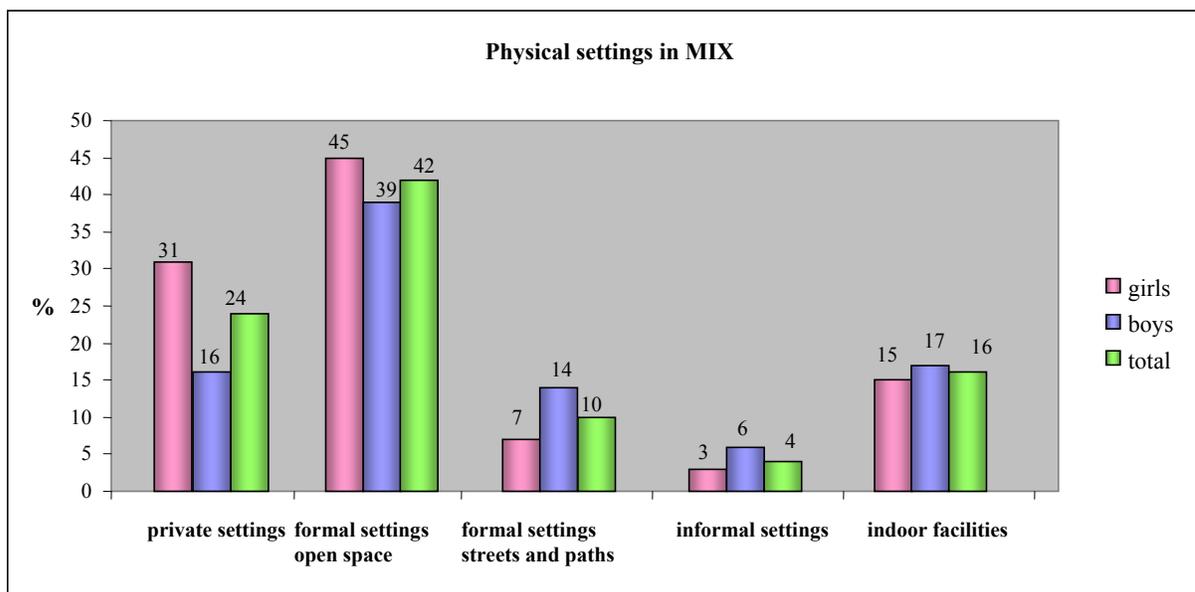


Figure 23: Physical settings in the mixed-use neighborhood

As shown in table 15a, the most frequently visited settings were: *formal open space* 42%, *private settings* 24%, *indoor facilities* 16%, and *streets and formal paths* 10%. *Informal settings* were rarely visited. The girls visited 15% more *private settings* than the boys and 6% more *open space*, but the boys used *streets and paths* 7% more and *informal settings* 7% more than the girls. The use of *indoor facilities* was similar among the genders.

About half of the total settings in 16 types of settings visited were used during the five schooldays. The distribution by main categories, as shown in table 15b, was: *formal open space*

(36%), *indoor facilities* (26%), *private settings* (22%), *streets and formal paths* (12%), and *informal settings* (3%).

The most frequently recorded *formal open space* types of settings were: the swimming pool (48%), parks and playgrounds (29%), and recreational and sport fields (18%). The use of *indoor facilities* was almost entirely limited to the school. Tertiary streets such as cul-de-sacs and back-alleys and formal paths such as sidewalks and greenways were the most commonly recorded *streets and formal paths* types of settings. The greatest gender differences were that the girls used *private settings* more than the boys, who used *streets and formal paths* more than the girls. Especially noteworthy was that the boys used recreational fields more than the girls, who used parks and playgrounds more than the boys. The boys also used primary and secondary streets more than the girls and were also more around the neighborhood.

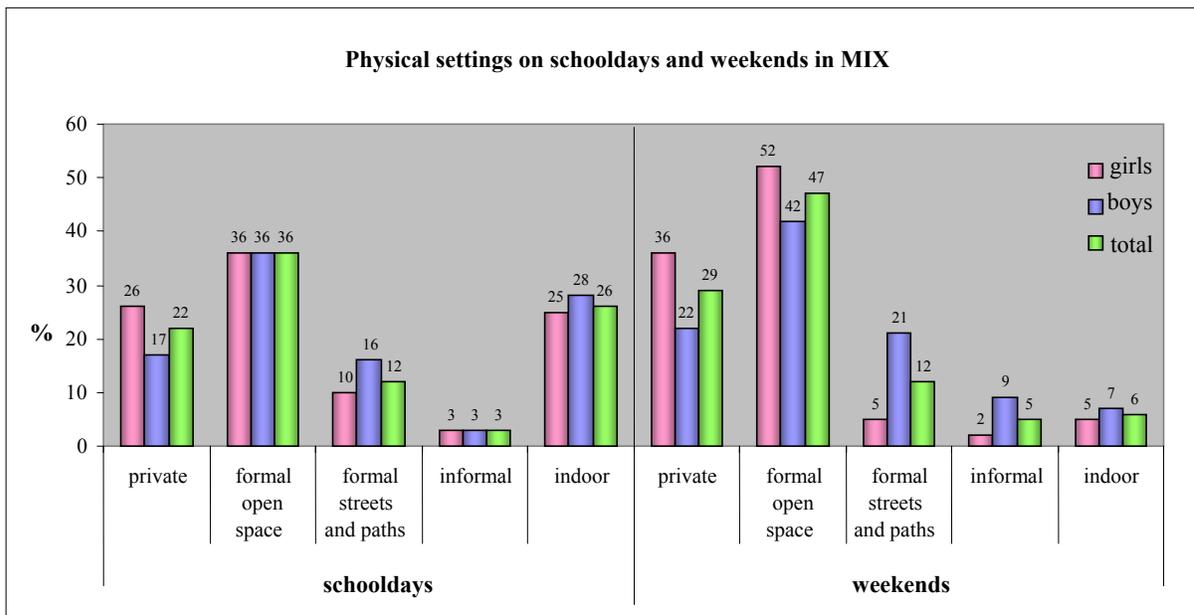


Figure 24: Physical settings in the mixed-use neighborhood on schooldays and weekends

On weekends, the children in the mixed-use neighborhood used 18 types of settings. The distribution by main categories, as shown in table 15c, was: *formal open space* (47%), *private settings* (29%), *streets and formal paths* (12%), *indoor facilities* (6%), and *informal settings* (5%). The most frequently recorded *formal open space* types of settings were: the swimming pool (74%) and parks and playgrounds (14%). The most used *indoor facility* was the movie theater. Tertiary streets and formal paths were the most commonly recorded *streets and formal paths* types of settings. The

greatest gender differences were that the girls used *private settings* and *formal open space* more than the boys, who used *streets and formal paths* more than the girls. Especially noteworthy was that the boys used recreational fields more than the girls, who used parks and playgrounds 31% more than the boys.

4.2.2 Physical Settings in the Traditional Neighborhood

In the activity log, the 21 children in the traditional neighborhood used 13 settings types during the nine days (see sub-categories in classification of neighborhood setting in appendix V).

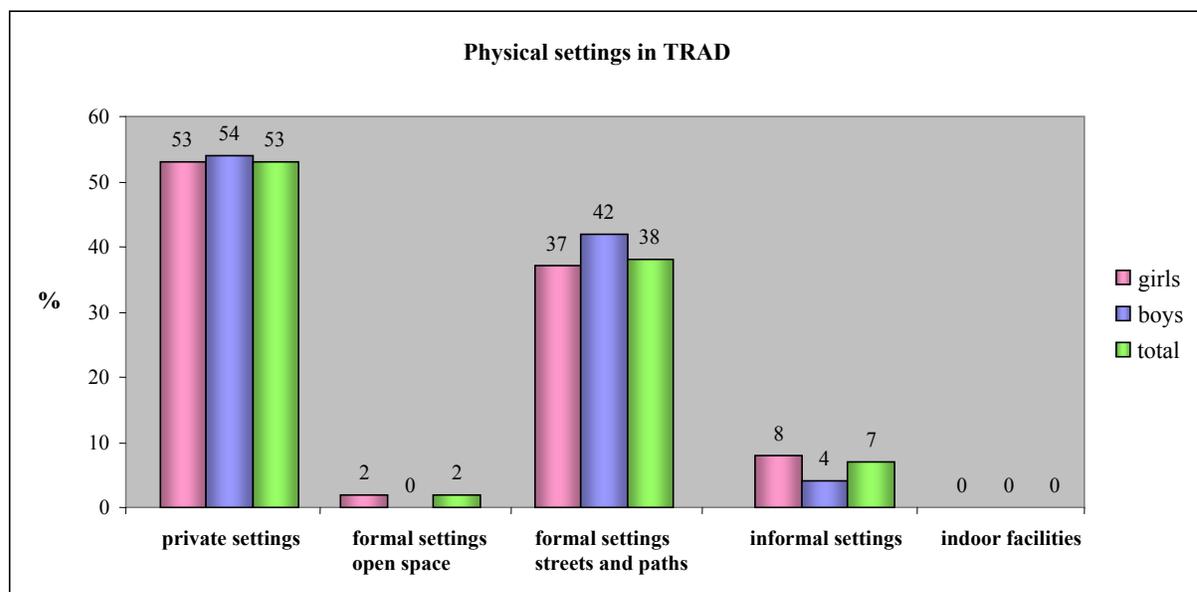


Figure 25: Physical settings in the traditional neighborhood

As shown in table 15a, the most frequently visited settings were: *private settings* (53%), *streets and formal paths* (38%), and *informal settings* (7%). The distribution by gender was similar.

On schooldays, the children in the traditional neighborhood recorded 12 types of settings. The distribution by main categories, as shown in table 15b, was: *private settings* 56%, *streets and formal paths* 32%, and *informal settings* 7%. Most of the *streets and formal paths* types of settings were tertiary streets (cul-de-sacs). Also noteworthy was that the boys use primary and secondary streets 23% more than the girls, who use streets settings such as corners 16% more than the boys.

On weekends, they used 12 types of settings. The distribution by main categories, as shown in table 15c, was: *private settings* 50%, *streets and formal paths* 40%, *informal settings* 6%, and

formal open spaces 4%. As with the schooldays data, the most frequently used types of *streets and formal paths* were tertiary streets and around the neighborhood.

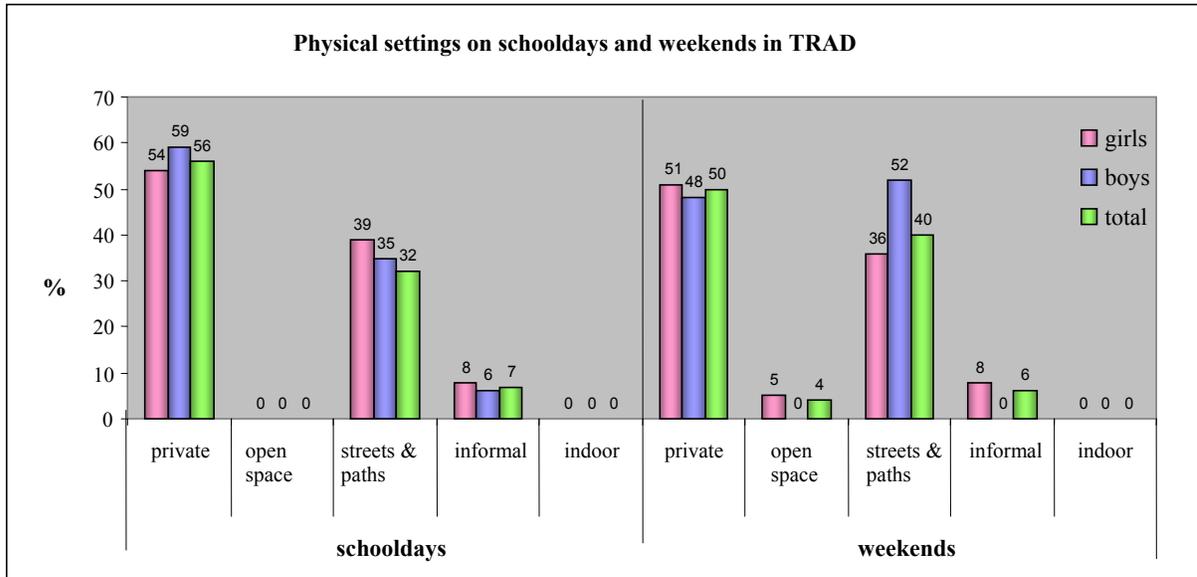


Figure 26: Physical settings on schooldays and weekends in the traditional neighborhood

4.2.3 Physical Settings in the Co-housing Neighborhood

In the activity log, the four children in the co-housing neighborhood used 11 settings types during the nine days (see sub-categories in classification of neighborhood setting in appendix V).

As shown in table 15a, the settings visited were: *streets and formal paths* (40%), *formal open space* (34%), *private settings* (19%), *informal settings* (5%), and *indoor facilities* (2%). The most frequently used *streets and formal paths* were: around the neighborhood 73% and formal paths 20%. Easily the most commonly used type of *formal open space* setting was *parks, playground etc.* (97%).

On schooldays, the children in the co-housing neighborhood recorded 10 types of settings. The distribution by main categories, as shown in table 15b, was: *streets and formal paths* 42%, *formal open space* 35%, *private settings* 17%, and *informal settings* 5%. Most of the *streets and formal paths* types of settings were a combination of streets and paths used to go around the neighborhood and the playground was the most used formal open space.

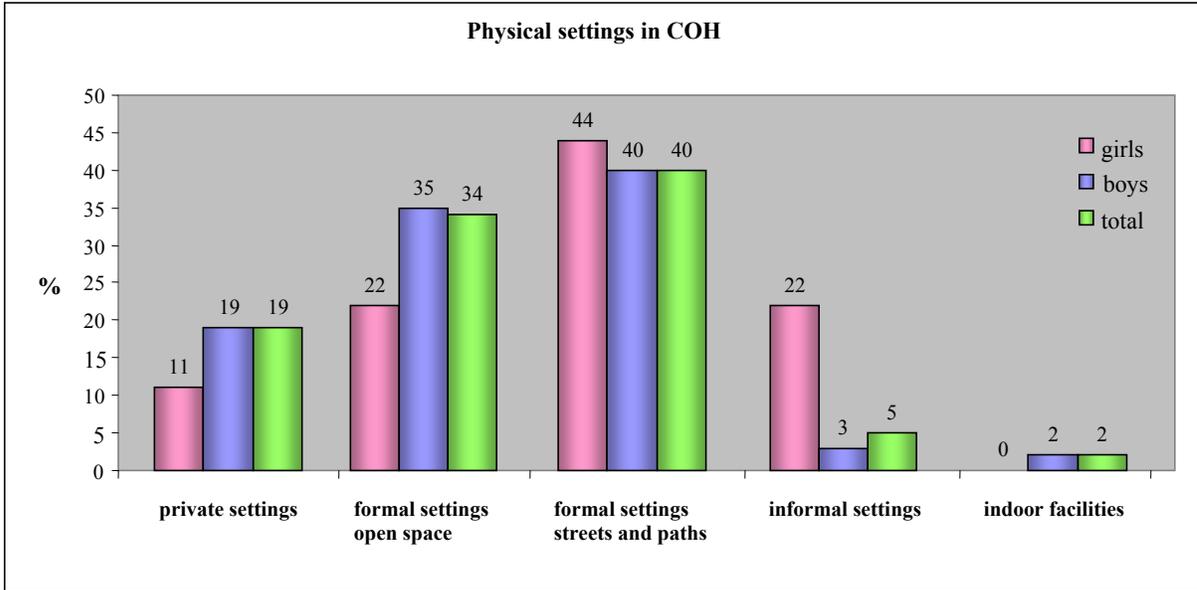


Figure 27: Physical settings in the co-housing neighborhood

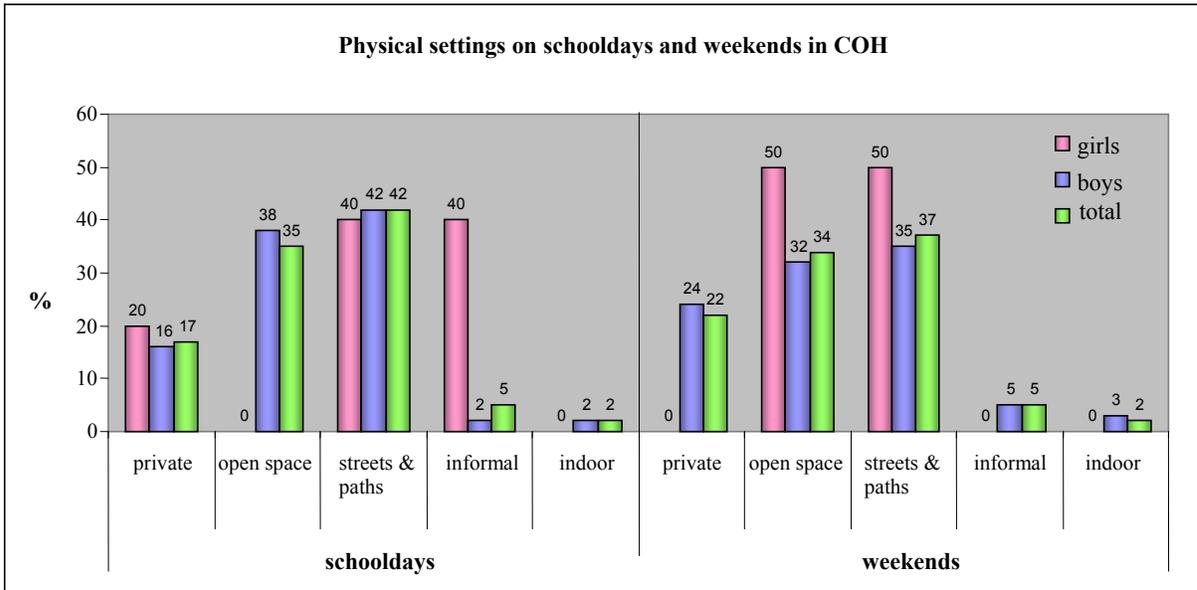


Figure 28: Physical settings on schooldays and weekends in the co-housing neighborhood

On weekends, they used 8 types of settings. The distribution by main categories, as shown in table 15c, was: *streets and formal paths 37%, formal open space 34%, private settings 22%, informal*

settings 5%, and indoor facilities (the community center) 2%. Thus, the distribution on schooldays and weekends was similar.

4.2.4 Comparing Physical Settings used in the Three Neighborhoods

The findings showed a difference in the distribution by neighborhood. As shown in table 11, almost 90% of the total activities (and thus settings) used in the mixed-use and co-housing neighborhoods were within the neighborhood, but only about 60% in the traditional neighborhood.

Number of Types of Physical Settings in the Neighborhoods

The children in the mixed-use neighborhood used more variety of types of settings than those in the traditional and co-housing neighborhoods or 18 types of settings compared to 13 in the traditional neighborhood and 11 in the co-housing community. The findings for the distribution on schooldays and weekends were similar.

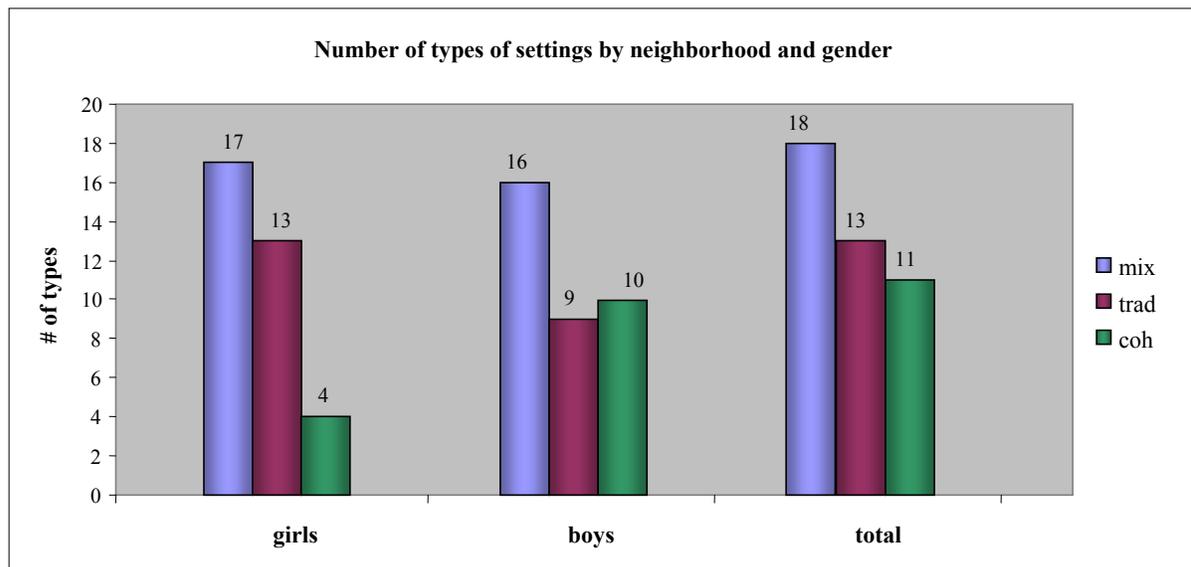


Figure 29: Number of types of settings by neighborhood and gender

The findings for the number of types of settings used by gender were mostly in consonance with the total set. However, the small difference between boys in the traditional and co-housing neighborhoods and between boys and girls in the mixed-use neighborhood was noteworthy, keeping in mind the difference in populations; the boys in the traditional neighborhood were twice as many as the boys in

the co-housing community and the girls in the mixed-use neighborhood were twice as many as the boys.

Types of Physical Settings in the Neighborhoods

Comparing the types of settings used in the neighborhoods was one of the main objectives in this research. The four main categories relating to types of settings used were *private settings*, *formal settings*, *informal settings*, and *indoor facilities*. The data was collected by the children’s activity log.

As shown in table 15a, the 21 children in the traditional neighborhood used *private settings* (yards and homes) 29% more than those in the 23 children mixed-use neighborhood. The four children in the co-housing community used this type of settings less than the children in the other two localities, especially those in the traditional neighborhood. The distribution for this type of settings on schooldays and weekends was similar.

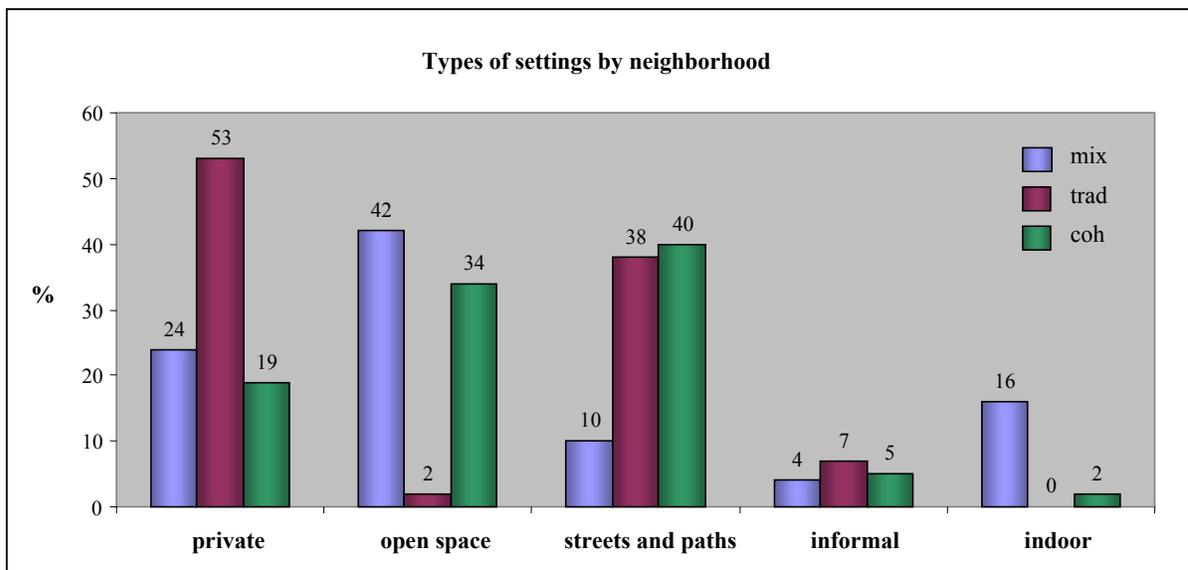


Figure 30: Types of settings by neighborhood

The children in the in mixed-use neighborhood used *formal open spaces* 8% more than those in the co-housing community and 40% more than those in the traditional neighborhood. As shown in table 15b and 15c, the distribution on schooldays and weekends was similar in the traditional and the co-housing neighborhoods, but in the mixed-use neighborhood the children used these types of places 15% more on weekends. The types of open space used in the co-housing neighborhood were mainly *parks* and *play areas* (97%), but in the mixed-use neighborhood, the *swimming pool* was by far the

most used setting (63%), especially on weekends (74%) and parks and playgrounds were also commonly used, especially on schooldays (29%).

The children in the traditional and co-housing neighborhoods used *streets and formal paths* about 30% more than those in the mixed-use neighborhood. In the traditional neighborhood, tertiary streets (51%) and specific streets settings (14%) were the most used sub-categories and in the mixed-use neighborhood, the children used tertiary streets (46%), formal paths (37%) and primary and secondary streets (25). The most commonly used settings in the co-housing community were a combination of streets and paths (*around the neighborhood* type of activity) which relates to the internal pedestrian path network.

The same two *informal settings* - *natural areas* and *natural areas w/ water* - were recorded in all of the neighborhoods and the distribution was similar throughout, ranging from 4-7% on schooldays and weekends. The gender distribution within the two neighborhoods was also similar.

In the mixed-use neighborhood, 16 percent of the total destinations were *indoor facilities*. On schooldays, 26% of the destinations were *the school* but on weekends, *the movie theater* was the most commonly setting. No indoor settings were recorded in the traditional neighborhood and only one in the co-housing neighborhood, the community center.

Types of Physical Settings in the Neighborhoods by Gender

The girls in the traditional neighborhood used 22% more *private settings* than those in the mixed-use neighborhood, who used 43% more *formal open spaces* more. A similar pattern was found among the boys, that is, those in the traditional neighborhood used 38% more *private settings* and 28% more *streets and formal paths* than those in the mixed-use neighborhood, who used 39% more *formal open space* and 17% more *indoor facilities*. The use of *informal settings* was similar. The low number of participants in the co-housing neighborhood makes any comparisons difficult, but the high use of *streets and formal paths* (40%) and *open space* (35%) was noteworthy.

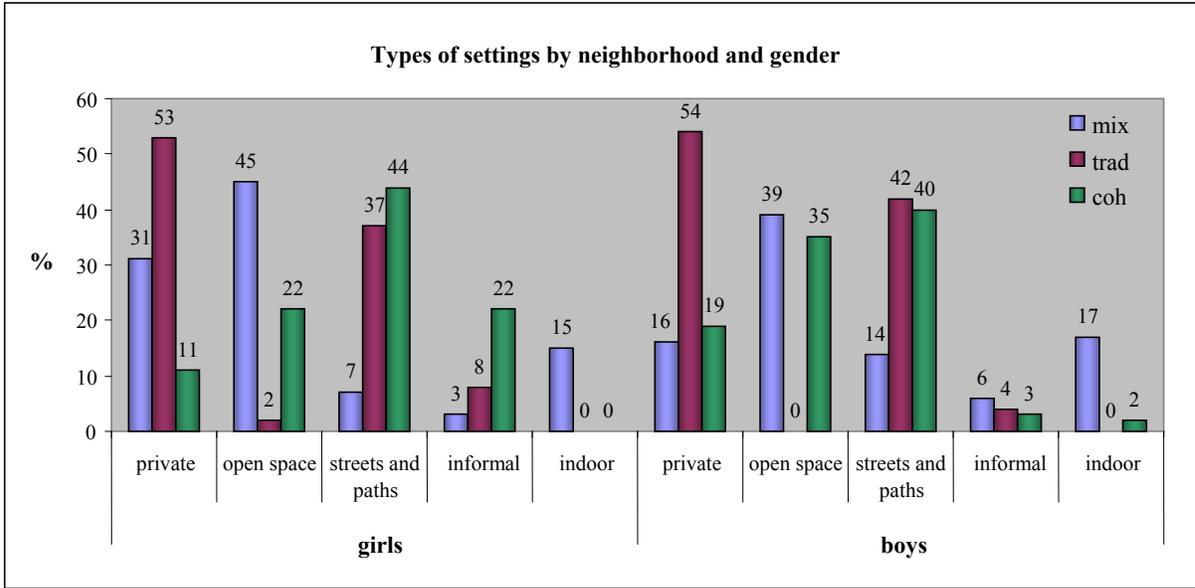


Figure 31: Types of settings by neighborhood and gender

4.2.5 Parents' Perception of Opportunities for Children's Outdoor Activities

In the standardized parental questionnaire the 58 parents were asked to rate the physical environment in their neighborhood in terms of opportunities for children's outdoor activities.

The six participating parents in the co-housing locality found opportunities for children's outdoor activities in the neighborhood very good, about 80% parents in the mixed-use neighborhood, but only 35% of the parents in the traditional neighborhood. This was especially true for parents of girls in the traditional neighborhood whereas 75% find their neighborhood offer fair opportunities for children's activities.

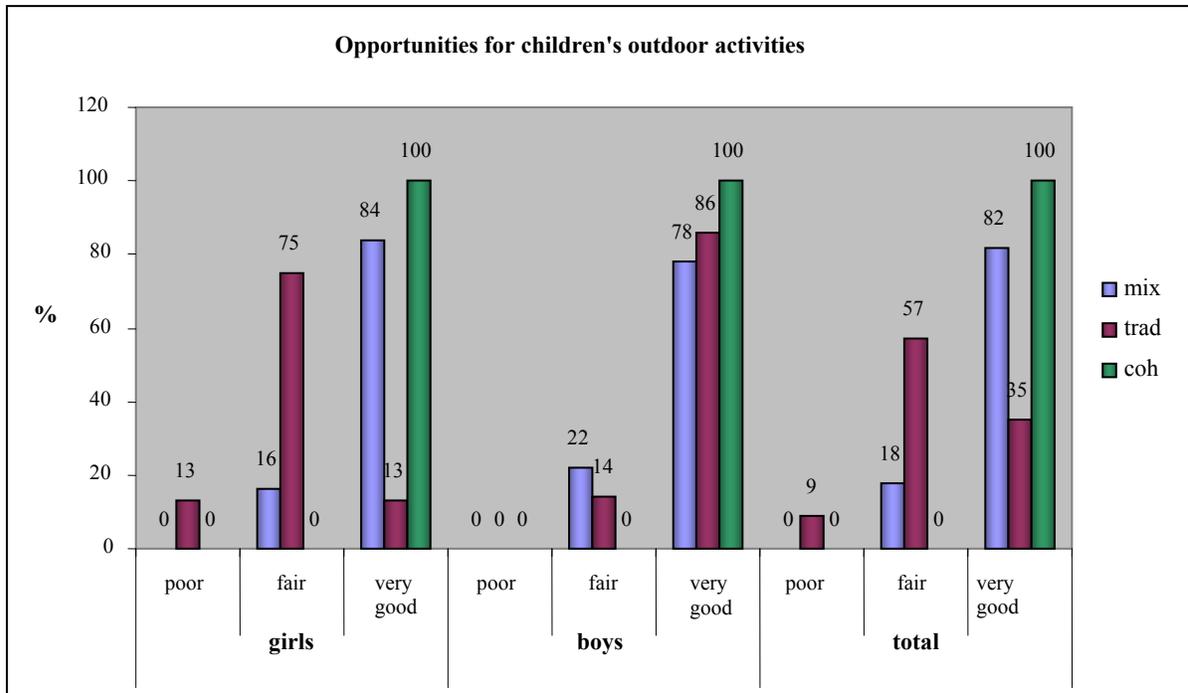


Figure 32: Opportunities for children's outdoor activities

4.2.6 Summary of Findings for Physical Settings

During the nine days tallied, 90% of the settings used in the mixed-use neighborhood and three out of four in the co-housing community took place within the neighborhoods, compared to 60% in the traditional neighborhood.

The children in the mixed-use neighborhood also used more varied types of settings than the children in the other two neighborhoods. The girls in the mixed-use and traditional neighborhoods used a greater number of types of settings than the boys. However, the findings should be interpreted keeping in mind that there were more girls than boys in both neighborhoods. In fact, the findings for average numbers of settings used supports indications that boys use a broader range of settings in both neighborhoods. Differences in total and gender population made any comparisons to the co-housing community difficult.

Looking at the types of settings used, the children in the traditional neighborhood used more *private setting*, than the children in the other two neighborhoods, who used more *formal open space*. Of the open space destinations, the most common setting in the co-housing community was the *playground*, and in the mixed-use neighborhood the *swimming pool* was the most used type of setting.

The children in the traditional and co-housing neighborhoods used *streets and paths* more than those in the mixed-use neighborhood. When scrutinizing the data, more than half of the *streets and formal paths* settings in the traditional neighborhood were *tertiary streets* (cul-de-sacs), but 2/3 of the destinations in the co-housing neighborhood were a combination of a dead-end streets and circular pedestrian paths (*around the neighborhood*). The distribution of this type of *streets and formal paths* in the mixed-use neighborhood was about even, between *primary and secondary streets*, *tertiary streets*, mostly back alleys and cul-de-sac and *formal paths* such as sidewalks and greenways. *Informal settings* such as natural areas and neighborhood *exploration* were rarely mentioned and *indoor settings* were mostly limited to the mixed-use neighborhood, especially the school on schooldays and the movie theater on weekends.

The gender distribution was largely in line with the findings for the total set. The girls and the boys in the traditional neighborhood used *private settings* and *streets and formal paths* than those in the mixed-use neighborhood, who used *formal open spaces* and *indoor facilities* more frequently. The use of *informal settings* was similar. The high use of *formal paths* and *open space* in the co-housing community was noteworthy.

Most parents in the mixed-use and co-housing neighborhoods consider opportunities for children's outdoor activities very good but only 35% of the parents in the traditional neighborhood. The findings further emphasize the point that neighborhoods do not fulfill girls' needs for outdoor activities. This was particularly true for the traditional neighborhood.

4.3 Children's Mobility within the Neighborhood

This section examined the third research question: *What is the relationship between neighborhood morphology and children's mobility?* The section is divided into four sub-sections each led by a sub-research question: (i) types of non-localized physical activities, (ii) types of linear settings, and (iii) distances traveled within the neighborhood.

4.3.1 Non-localized Physical Activities

Of special interest in this research was the distribution of non-localized (*travel between places*) physical activities within the neighborhoods, particularly the relationship to the use of paths, the

location of the elementary school, and the geographical size of the neighborhood. Data were collected through the structured survey in the children’s activity log. A total of 327 non-localized physical activities were recorded during the nine days tallied.

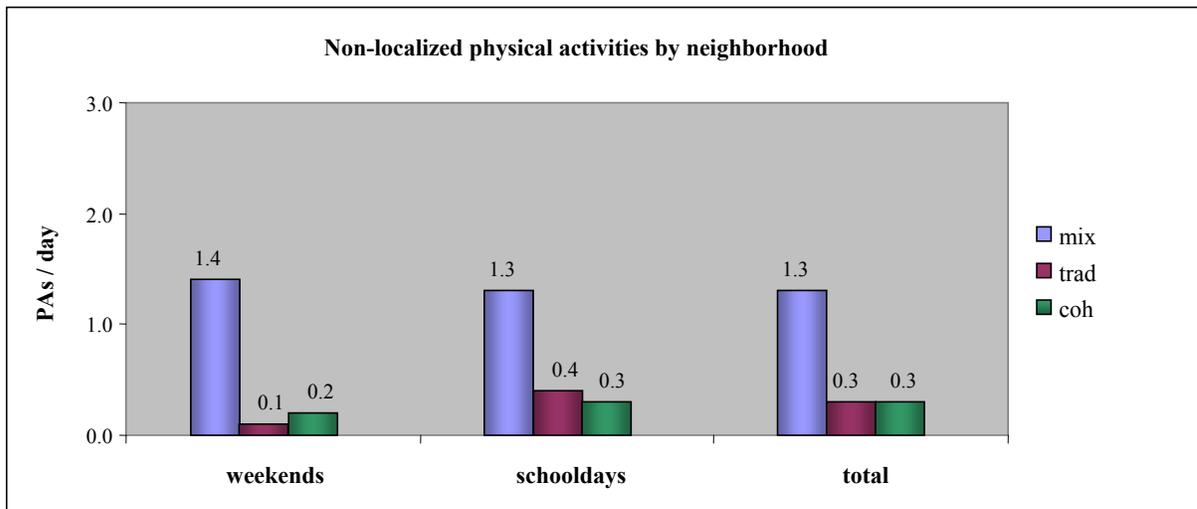


Figure 33: Non-localized physical activities by neighborhood

As shown in table 12a, 49% of the total activities in the mixed-use neighborhood during the nine days were non-localized. As revealed in table 16a, the average number of activities was 1.3 PAs/day; 1.6 PAs/day for the boys and 1.2 PAs/day for the girls. During the nine days, as shown in table 16a, 49% of the total neighborhood activities in the mixed-use neighborhood were non-localized; an average of 1.3 PAs/day. The boys used this type of activity more than the girls, especially on schooldays.

In the traditional neighborhood this type of activity counted for 19% of the activities; an average of 0.3 PAs/day and with a similar engagement by gender. In the co-housing neighborhood, this type of activity counted for 9% of the total set; an average of 0.3 PAs/day and with a similar distribution on schooldays and weekends and by gender. Thus, the children in the mixed-use neighborhood used 1.0 PAs/day more non-localized PAs/day during the nine days than the children in the other two neighborhoods. This was true for the girls and the boys though the differences among the boys were greater, ranging from +1.3-1.4 PAs/day.

As shown in table, 16b, there was a difference in the distribution of non-localized activities on schooldays with 54% of the *lifestyle activities* in the mixed-use neighborhood, 27% in the traditional, and 10% in the co-housing community. The average number of non-localized activities reflects this difference: the children in the mixed-use neighborhood used 0.9 to 1.0 more PAs/day

than the children in the other two neighborhoods. This was true for the girls and the boys. Looking at the gender distribution across the neighborhoods, the girls in the mixed-use neighborhood recorded 0.7-0.9 more PAs/day on schooldays than the girls in the other two neighborhoods. The boys in the mixed-use neighborhood were also more engaged in this type of activity than those in the traditional and the co-housing neighborhoods, or 1.3 more PAs/day.

There was also a difference in the distribution on weekends by neighborhood with 44% of the *lifestyle activities* in the mixed-use neighborhood, 9% in the traditional neighborhood, and 8% in the co-housing neighborhood being non-localized. The average number of activities reflects this difference: the children in the mixed-use neighborhood used 1.3 more PAs/day than those in the traditional and 1.2 more PAs/day than those in the co-housing neighborhood. This was true for the girls and the boys.

4.3.2 Linear Physical Settings

Since all activities take place in physical settings, the findings from previous section, in terms of total and average numbers of non-localized physical activities, also applies to this section on the types of linear settings used in the neighborhoods. Data on linear settings were collected through the structured survey in the children's activity log. A total of 327 non-localized physical activities/linear settings were used during the nine days tallied.

Linear Settings in the Mixed-use Neighborhood

As shown in table 16a, the children in the mixed-use neighborhood recorded a total of 270 non-localized activities/linear settings. The average number was 1.3 settings/day; 1.2 for the girls and 1.6 for the boys. The settings used were largely *formal paths* (93%) such as sidewalks and a paved greenway, although *primary and secondary streets*, *tertiary streets* such as back alleys, and *informal paths* were also recorded. The distribution on schooldays and weekends in terms of average number of activities was similar

Of the total linear settings, as shown in table 16b and c, 54% were recorded on schooldays and 46% on weekends. *Formal paths* were the most used type of setting on schooldays (97%) and weekends (88%). The other types used were *informal paths*, *primary and secondary streets*, and *tertiary streets*. On schooldays, the distribution by gender was similar but on weekends the girls use *formal paths* 8% more than the boys who used *tertiary streets* 9% more than the girls.

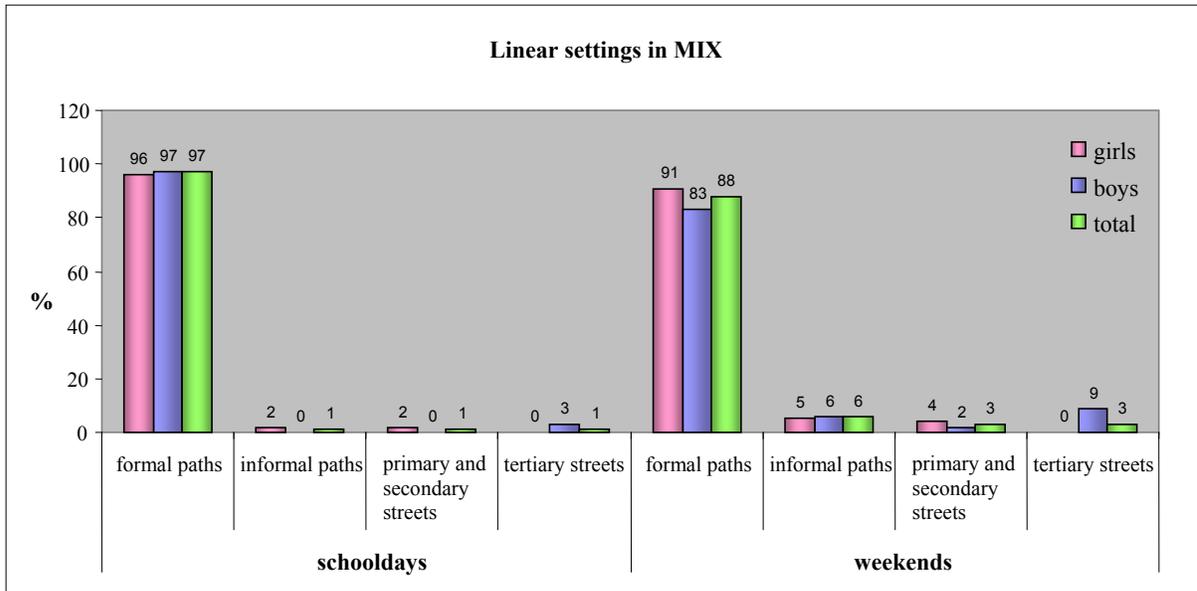


Figure 34: Linear settings used in the mixed-use neighborhood on schooldays and weekends

Linear Settings in the Traditional Neighborhood

As shown in table 16a, the children in the traditional neighborhood recorded 48 non-localized activities/linear settings. The average number was 0.3 settings/day; 0.3 for the girls and 0.2 for the boys. The settings 52% were *primary and secondary streets* and 44% *formal paths* such as sidewalks. They did not use *informal paths* and only 4% of the settings used were *tertiary streets*. The girls used *formal paths* 30% more than the boys, who used *primary and secondary streets* 35% more than the girls.

Of the total linear settings, as shown in table 16b and 16c, almost 80% were recorded on schooldays. The same types of linear settings were dominant on schooldays and weekends although the distribution was different, especially by gender. On schooldays 50% of the settings the girls used were *formal paths* (sidewalks) and 43% were *primary and secondary streets* whereas the boys mainly used *primary and secondary streets* (88%). The distribution by gender on weekends was the same: 50% *formal paths* and 50% *primary and secondary streets*.

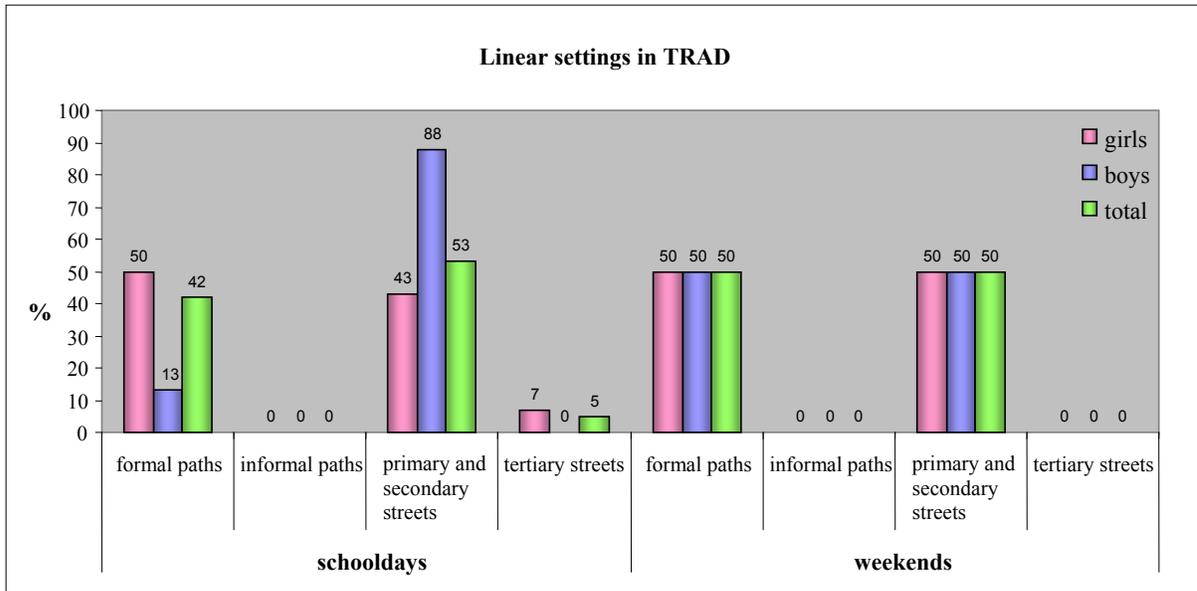


Figure 35: Linear settings used in the traditional neighborhood on schooldays and weekends

Linear Settings in the Co-housing Neighborhood

As shown in table 16a, the children in the co-housing neighborhood recorded 9 non-localized activities/linear settings. The average number was 0.3 settings/day; 0.2 for the girl and 0.3 for the boys. Seven of nine settings were *formal paths* and two were *primary streets*. The girl recorded two of the nine settings, one of each type, and the boys used *formal paths* six times and *primary and secondary streets* once.

Of the total linear settings, as shown in table 16b and 16c, 2/3 of the settings were recorded on schooldays; *formal paths* and *primary and secondary streets*. On weekends, they only used *formal paths*.

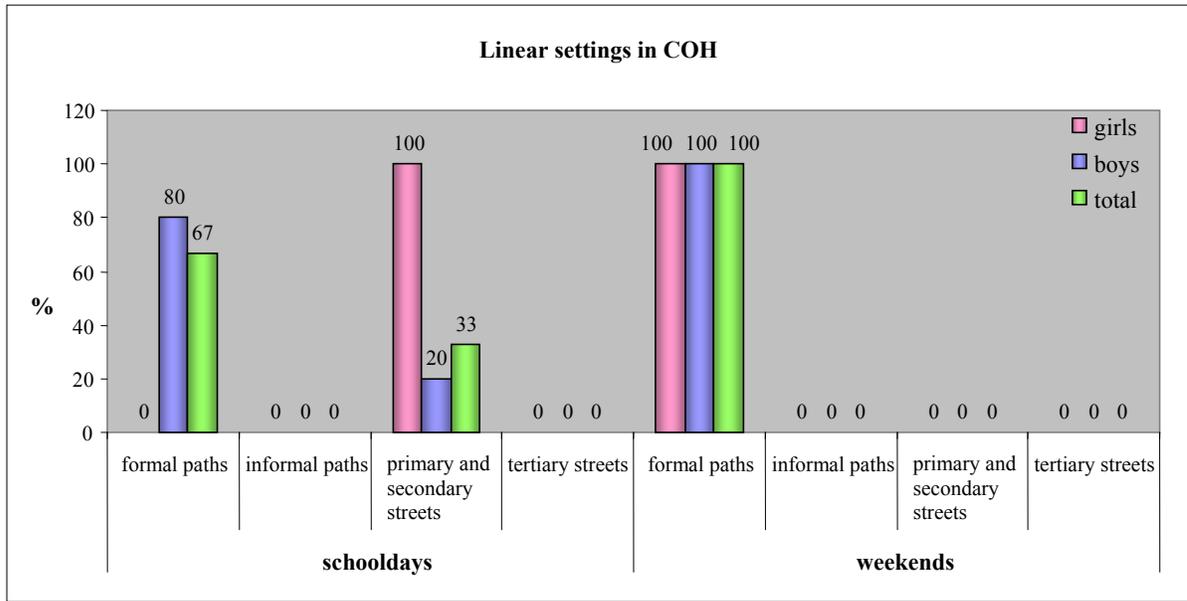


Figure 36: Linear settings used in the co-housing neighborhood on schooldays and weekends

Comparing Linear Settings in the Three Neighborhoods

As shown in table 16a, almost all of the linear settings used in the mixed-use neighborhood were *formal paths*. About $\frac{3}{4}$ of the settings used by the children in the co-housing neighborhood were *formal paths* and $\frac{1}{4}$ *primary and secondary streets*.

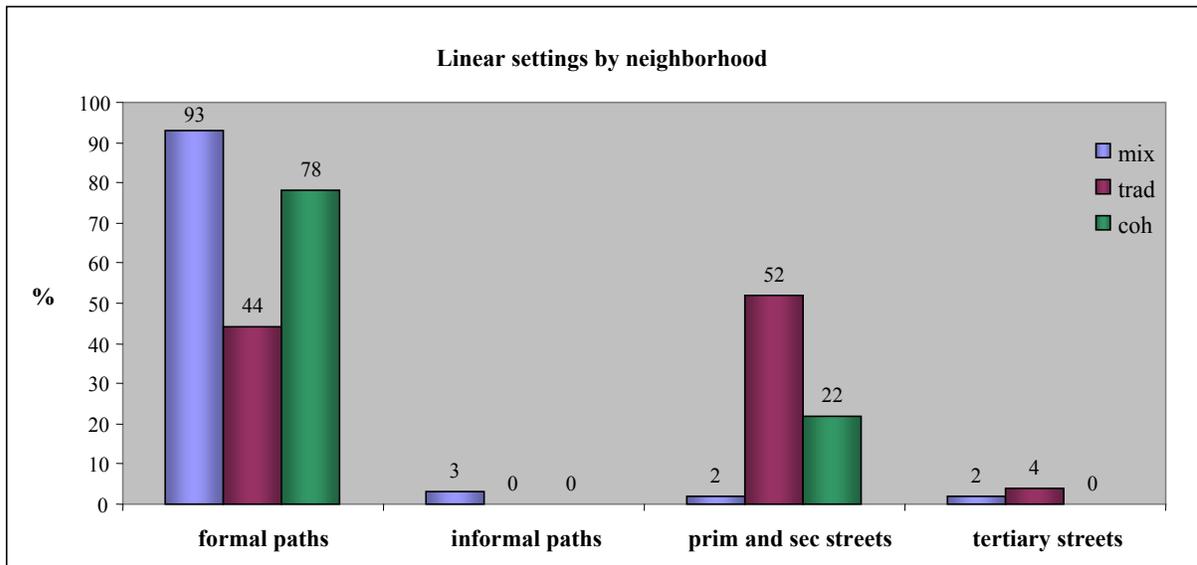


Figure 37: Types of linear settings by neighborhood

The distribution of settings used in the traditional neighborhood was more evenly distributed between *formal paths* (44%) and *primary and secondary streets* (52%). Thus, children in the mixed-use neighborhood used *formal paths* 49% more than those in the traditional neighborhood and 15% more than those in the co-housing community and children in the traditional neighborhood used *primary and secondary streets* 20% more than those in the co-housing community and 52% more than those in the mixed-use neighborhoods.

When comparing the linear settings used on schooldays and weekends, as shown in table 16b and c, the distribution in the mixed-use and traditional neighborhoods was similar but in the co-housing community the children used *formal paths* 33% more on weekends and *primary and secondary streets* 33% more on schooldays.

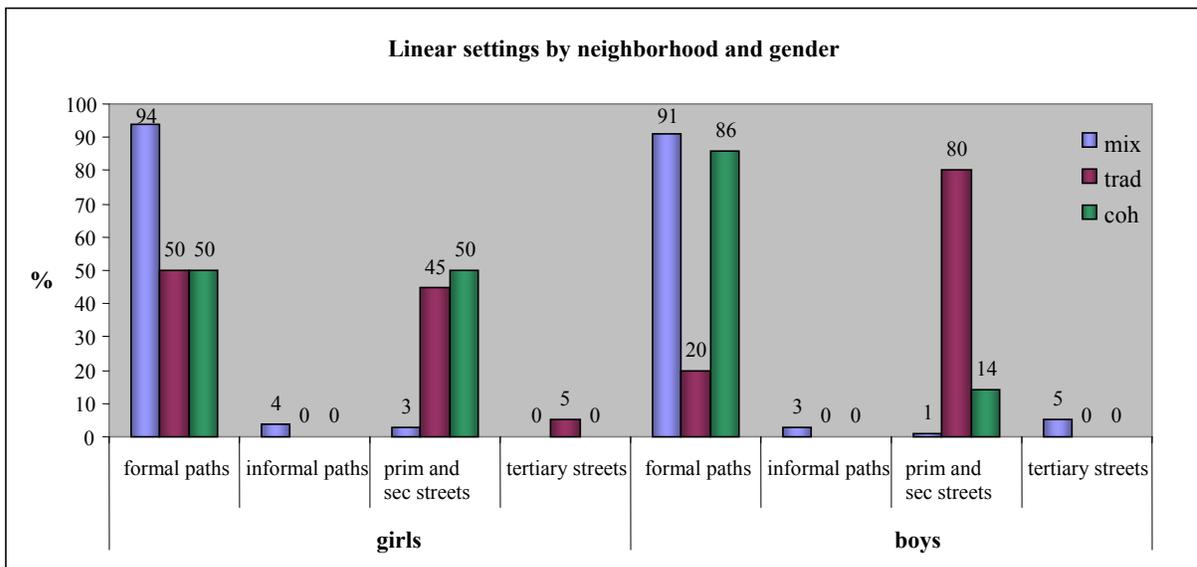


Figure 38: Linear settings by neighborhood and gender

There was little gender difference within the mixed-use neighborhood on schooldays but on weekends the girls used the *formal paths* 8% more than the boys who used *tertiary streets* 9% more than the girls. In the traditional neighborhood, there was no gender difference on weekends but on schooldays, the girls used 30% more *formal paths* and the boys 35% more *primary and secondary streets*. In the co-housing community, there was also no gender difference on weekends but on schooldays, the boys used *formal paths* more than the girl, who used *primary and secondary streets* more than the boys.

4.3.3 Distances Traveled in the Neighborhood

Of special interest in this research were the distances children travel within the neighborhoods, particularly the relationship to the use of paths, the location of the elementary school, and the geographical size of the neighborhood. Data were collected through a standardized parental questionnaire and children's activity logs.

Distances Traveled in the Mixed-use Neighborhood

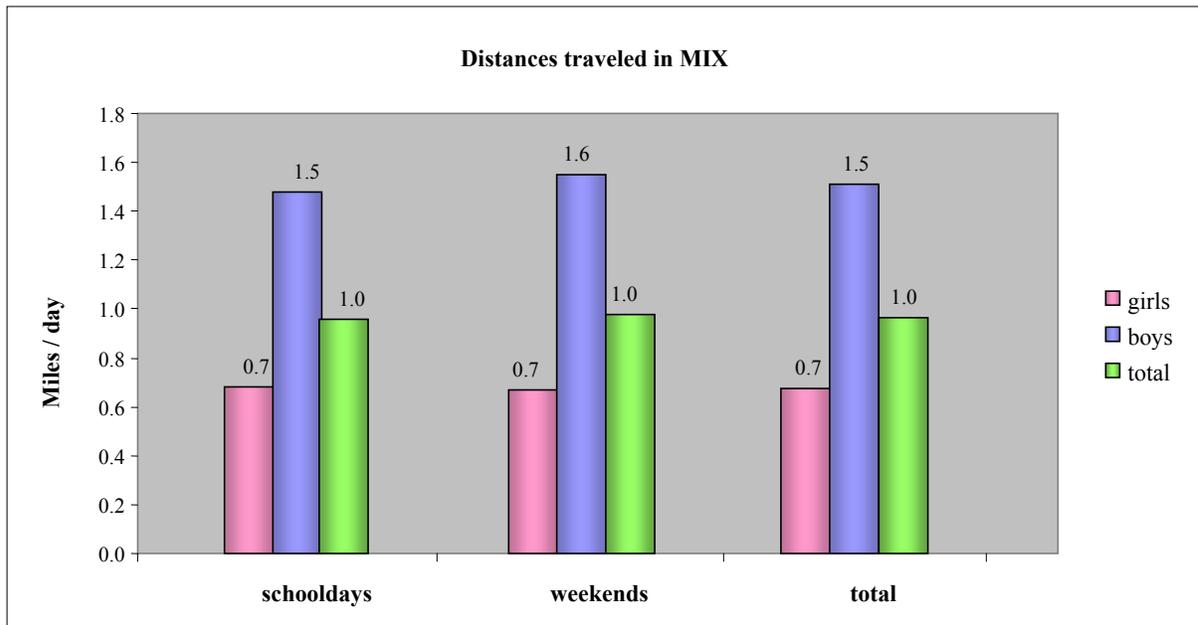


Figure 39: Distances traveled in the mixed-use neighborhood on schooldays and weekends

As shown in table 16d, the average distance traveled in the mixed-use neighborhood during the nine days was 0.97 miles/day; 1.51 miles/day for the boys, which is considerably greater than the 0.68 miles/day traveled by the girls. The distances traveled on schooldays and weekends were similar.



Figure 40: Home-range in the traditional neighborhood

(The map shows a summary of the physical settings used by each child but not the frequency of usage).

The nine maps for each child were compiled to examine the children’s home-range in the neighborhood. The findings show that the children travel between different sections of the neighborhood but rarely go beyond the borders of the built environment. Most of the children used the greenway, particularly on their way to school. The swimming pool and the movie theater were also used by many of the participants.

Distances Traveled in the Traditional Neighborhood

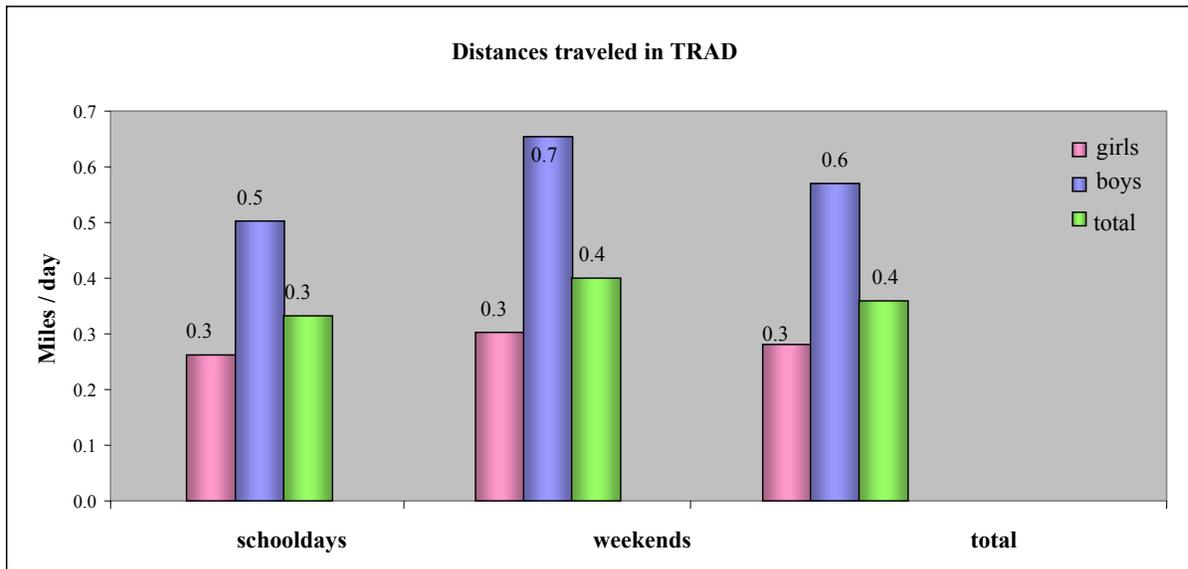


Figure 41: Distances traveled in the traditional neighborhood on schooldays and weekends

As shown in table 16d, the average distance traveled in the traditional neighborhood during the nine days was 0.36 miles/day. The boys traveled 0.57 miles/day or twice the 0.28 miles/day traveled by the girls. The distances traveled on schooldays and weekends were similar.

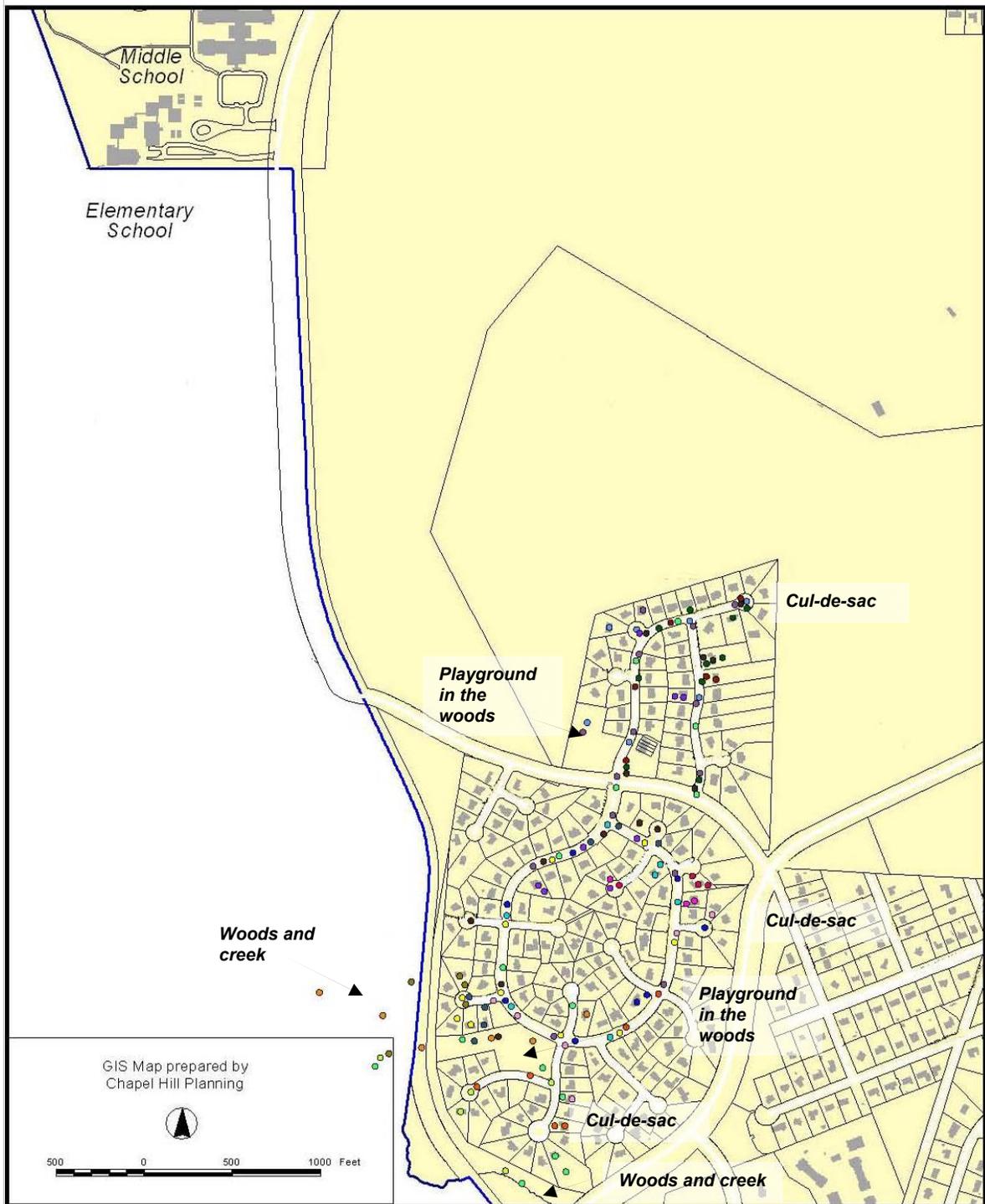


Figure 42: Home-range in the traditional neighborhood.

(The map shows a summary of the physical settings used by each child but not the frequency of usage).

The nine maps for each child were compiled to examine the children’s home-range in the neighborhood. The findings show that few children cross the road that cuts the neighborhood in two sections, the activities mostly take place around the homes, on the main streets, and in some of the cul-de-sacs. Only a few children go beyond the built environment. Those who do, follow a path to a creek in the woods.

Distances Traveled in the Co-housing Neighborhood

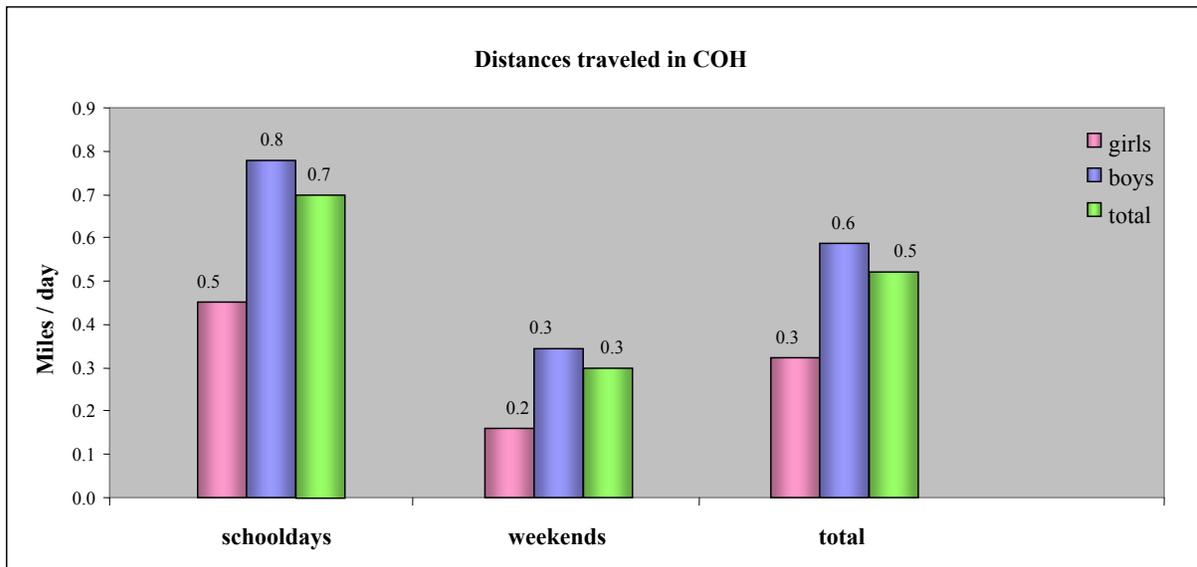


Figure 43: Distances traveled in the co-housing neighborhood on schooldays and weekends

As shown in table 16d, the average distance traveled in the co-housing neighborhood during the nine days was 0.52 miles/day. The boys traveled 0.59 miles/day or twice the 0.32 miles/day traveled by the girls. The distances traveled on schooldays were 0.40 miles/day greater than on weekends.

The nine maps for each child were compiled to examine the children’s home-range in the neighborhood. The findings show that few children mostly stay within the public open space on the inside of the neighborhood; particularly the paths and the playground. The dead-end access lane, the area around the pond, and the small grassy play area (ball field) were also used by the children. The intersection of the paths and the access lane served as an end point. Three out of four participants walked to school.

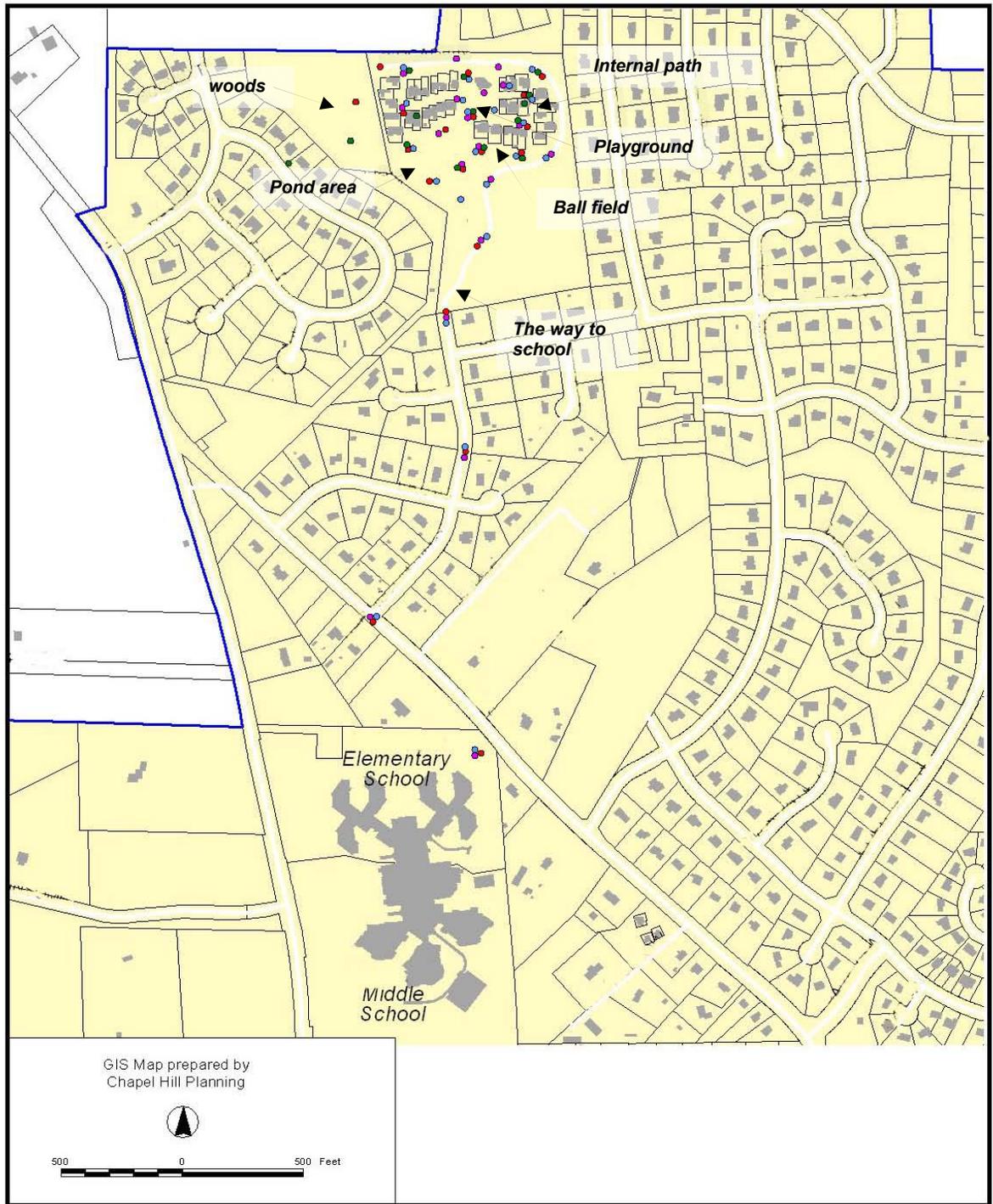


Figure 44: Home-range in the traditional neighborhood.

(The map shows a summary of the physical settings used by each child but not the frequency of usage).

Comparing Distances Traveled in the Three Neighborhoods

In this research, special focus was placed on the relationship between neighborhood morphology and the distances traveled by children. On the aerial photographs in the activity logs, the children traced the routes walked or cycled within the neighborhood.

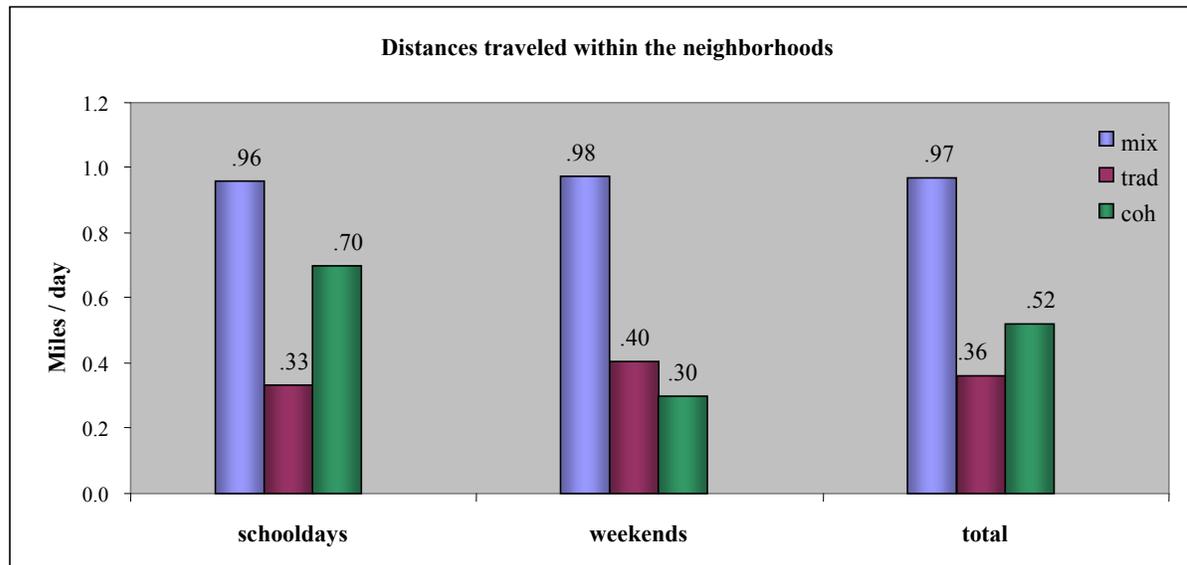


Figure 45: Distances traveled within the neighborhoods on schooldays and weekends

As shown in table 16d, the children in the mixed-use neighborhood traveled about 1.0 miles/day within the neighborhood on schooldays and weekends. In the traditional neighborhood, they traveled 0.36 miles/day, slightly more on weekends than schooldays. The average distance traveled in the cohousing neighborhood during the nine days was 0.52 mile, but the distribution on schooldays and weekends varied as they traveled much 0.40 miles/day further on schooldays. Thus, the children in the mixed-use neighborhood traveled about half a mile every day further than those in the other two neighborhoods and the walkability to school has affect on the distance traveled.

Distance Traveled the Furthest without an Adult

In the activity log, the participating children were asked to mark the furthest place they had traveled by foot from their home *without an adult*. The distance from home was measured by drawing a line (fly crow) from the child's home to the place marked.

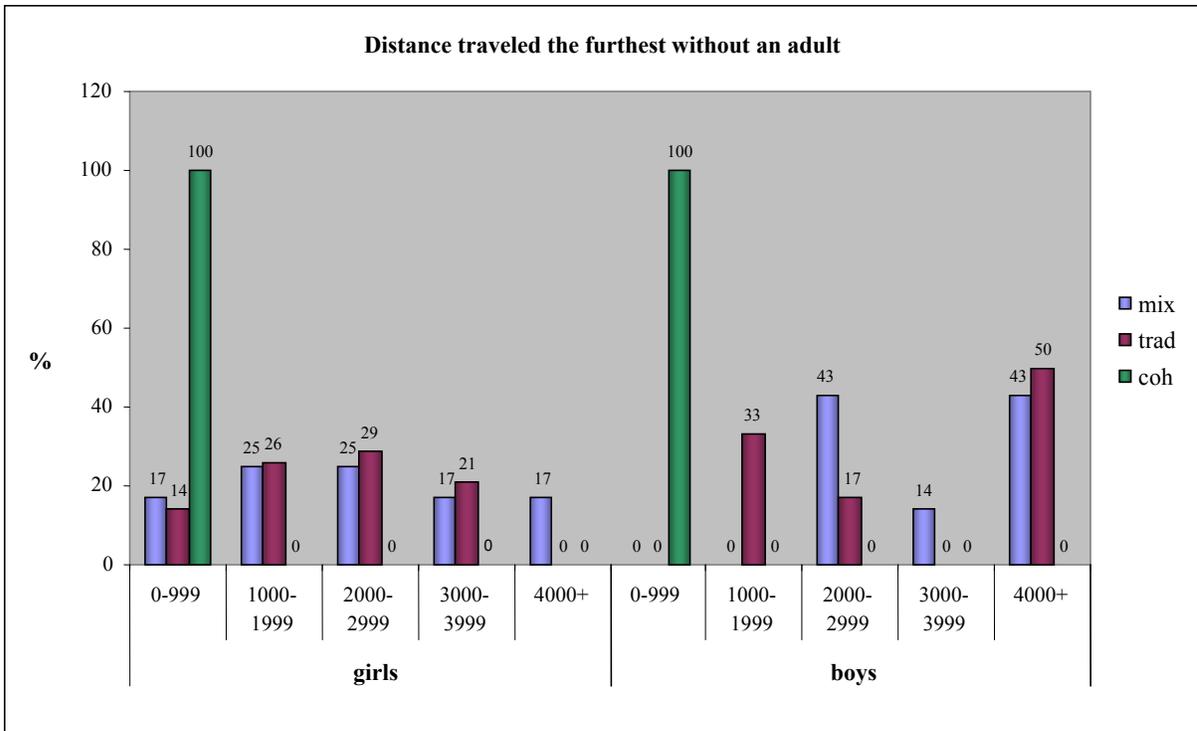
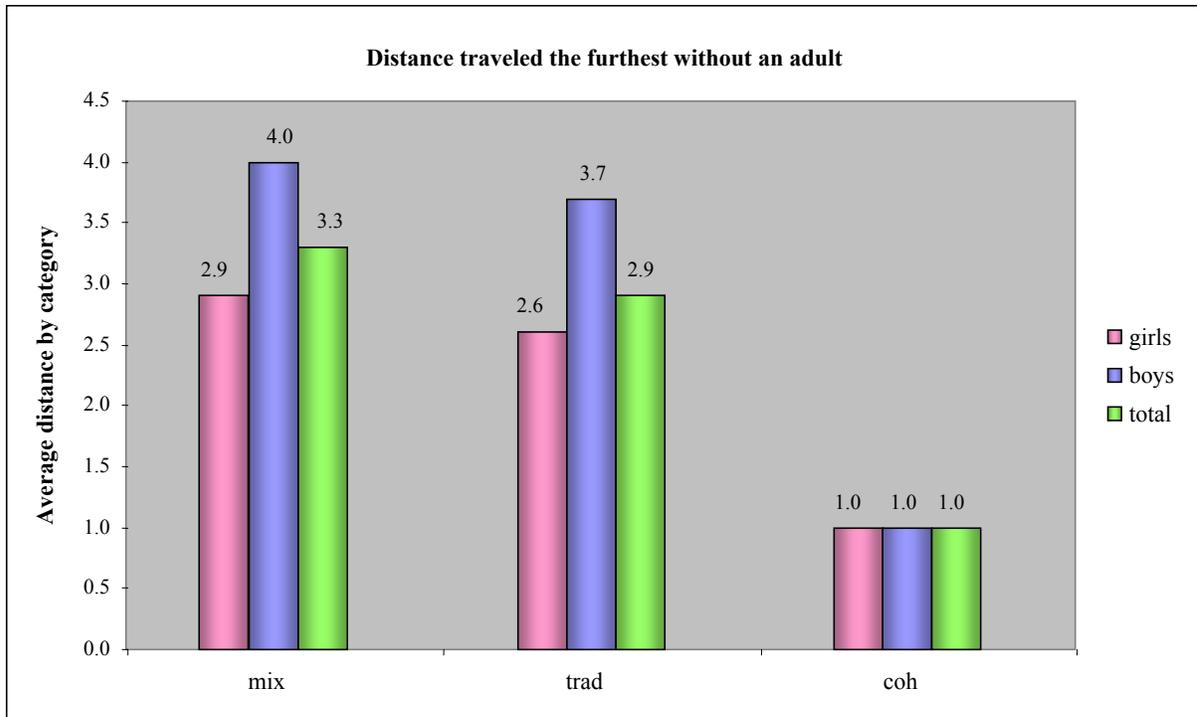


Figure 46: Distance traveled the furthest without an adult

In the Mixed-use neighborhood, as shown in table 16d, 32% of the 19 children who completed this section reported that they had traveled the furthest 2000-2999 feet, 26% had traveled further than 4000 feet, 16% between 3000-3999 feet, and 16% 1000-1999 feet. The boys had traveled further distances than the girls. In the traditional category, 35% of the 20 children who completed this section reported that they had traveled 1000-1999 feet, 25% 2000-2999 feet, 15% 3000-3999 feet, and 15% more than 4000 feet. The boys had traveled further distances than the girls. Three out of six boys have traveled 4.000 feet or more. None of the girls reported a place more than 4000 feet. Most of the girls (60%) have traveled between 1000 and 2000 feet. Only three children in the co-housing community participated in this section of the research. The places they marked in as the furthest they have gone to alone were all within 1.000 feet from the home. The findings also show that only a few children have explored to places further than 4000 feet from the home; 17% of the girls and 43% of the boys in the mixed-use neighborhood and 50% of the boys in the traditional neighborhood.



1= 0-999 ft, 2=1000-1999 ft, 3=2000-2999 ft, 4= 3000-3999 ft, 5= 4000 ft or further

Figure 47: Distance traveled the furthest without an adult

The mean in distance traveled without an adult was greater in the mixed-use neighborhood (3.3=2000-2999ft) than in the traditional neighborhood (2.9=1000-1999ft). The boys in the mixed-use and the traditional neighborhoods traveled further than the girls. The average distance for the boys in the mixed-use neighborhood was 4.0 (3000-3999 ft) but for the girls it was 2.9 (1000-1999 ft). The average for the boys in the traditional neighborhood was 3.7 (2000-2999 ft) and for the girls it was 2.6 (). The findings show that the children in the mixed-use category have traveled greater distances than children in the traditional neighborhood and the boys reported greater distances than the girls.

Distance Traveled to and from School

To further investigate the relationship between the school's location and non-localized activities, parents were also asked whether their child walks or cycles to school and back, and if so how far.

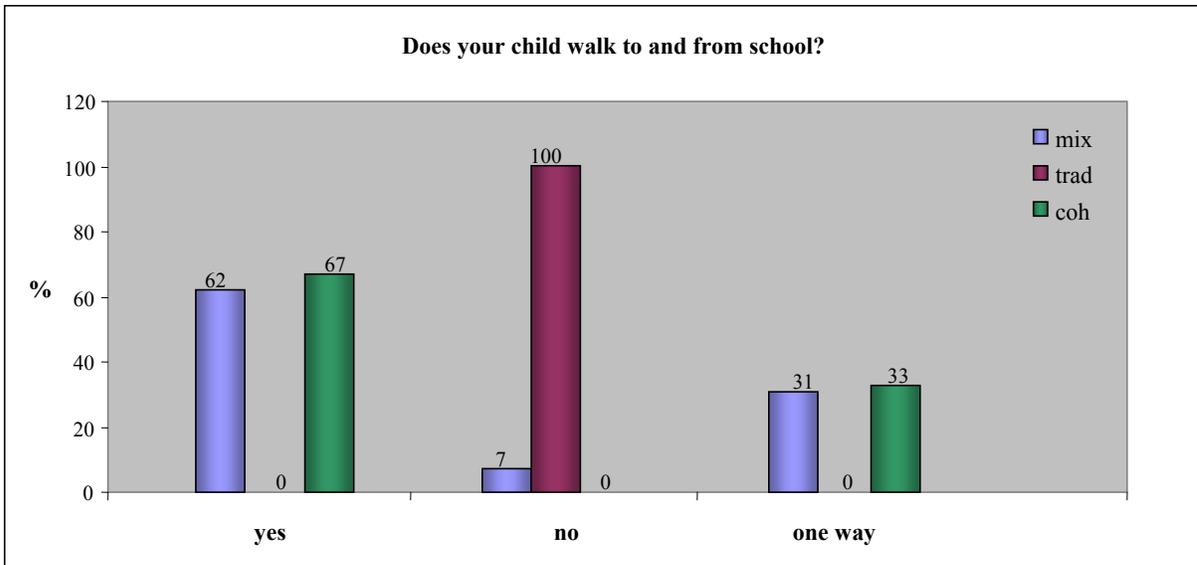


Figure 48: Children’s walking to and from school by neighborhood

None of the children in the traditional neighborhood walk or bike to and from school, 93% of the children in the mixed-use neighborhood walk or cycle to school at least one way on a regular basis, and all of those in the co-housing community.

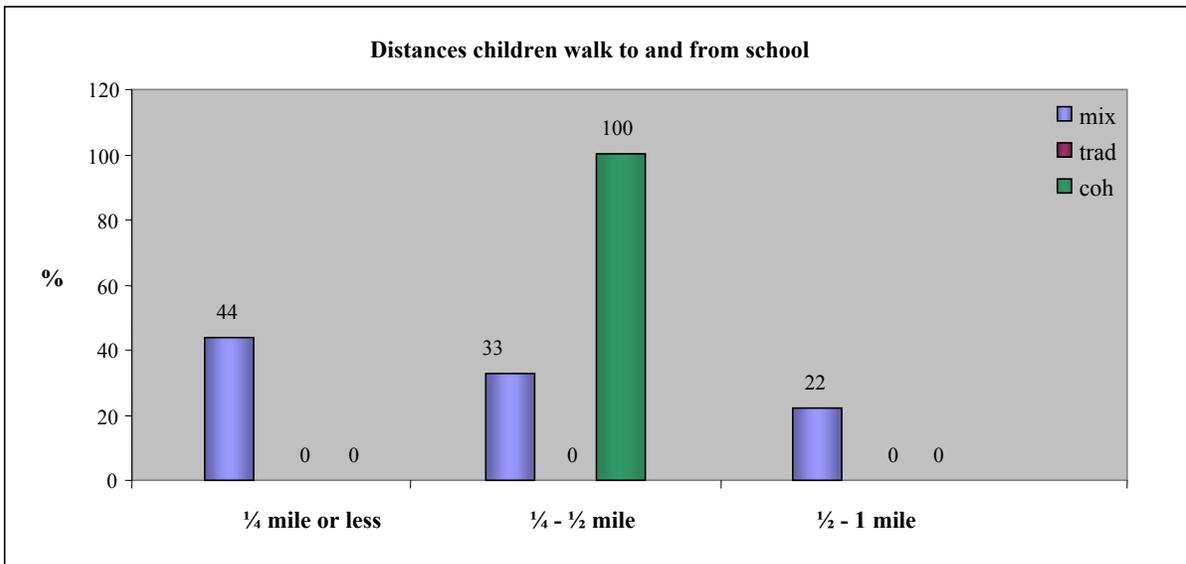


Figure 49: Distances children walk to and from school by neighborhood

Parents of children who walk to school were also asked about the distances they walk. Due to the small size of the co-housing neighborhood, the children travel the same distance or about ¼ to ½ a mile one way. In the mixed-use neighborhood, 44 percent of the parents estimated that their child walk or bikes ¼ mile or less, 33 percent ¼ to ½ mile, and 22 percent ½ to one mile. And as mentioned here above, none of the children in the traditional neighborhood walk or cycle to school.

4.3.4 Parents' Perception of Children's Safety

In the questionnaire, parents were asked about neighborhood safety (n=58) both *physical safety* (fear for their child getting hurt due to unsafe conditions in the physical neighborhood environment) and *social safety* (fear for their child getting hurt by someone) while being outdoors in the neighborhood.

Parents' Perception towards Children's Physical Safety

Of the parents in the mixed-use neighborhood, 41 percent find the physical environment *fairly safe* and 59 percent *very safe*. There was a difference in the distribution between parents of boys and girls whereas 50 percent of parents of girls find the physical environment *fairly safe* and 50 percent *very safe* but 22 percent of parents of boys consider it *fairly safe* and 78 percent consider it *very safe*.

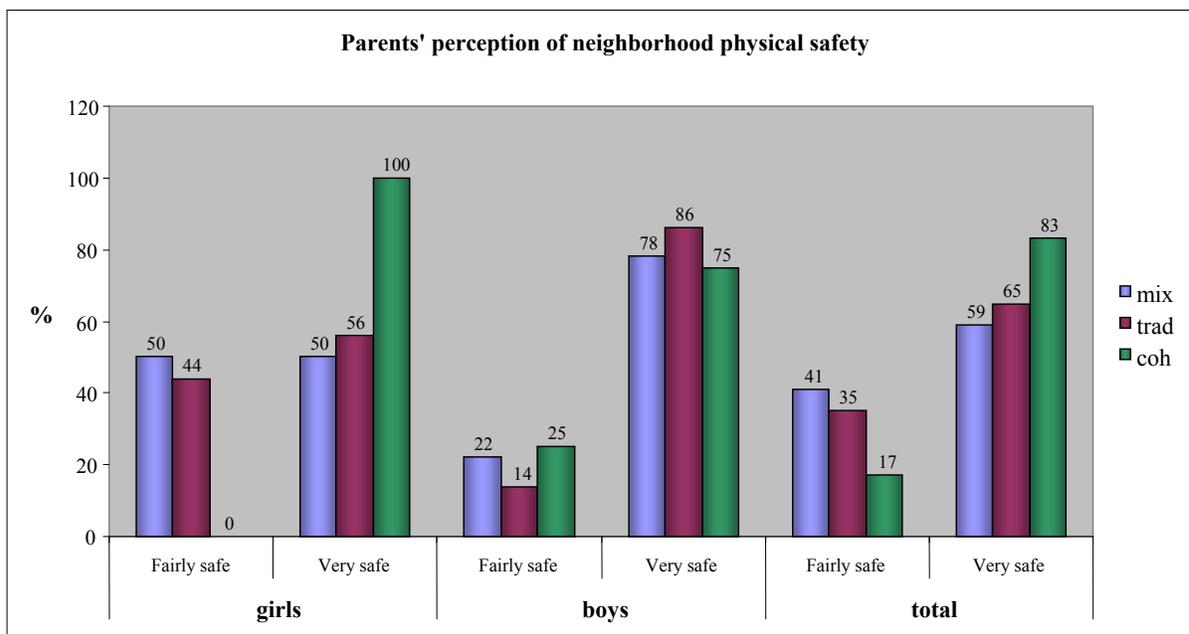


Figure 50: Parent's perception towards children's physical safety

As shown in table 18b, the average further underscores this difference: 2.5 (falls between *fairly safe* and *very safe*) for parents of girls and 2.8 for parents of boys (falls closer to *very safe*). The mean for the neighborhood was 2.6 (falls between *fairly safe* and *very safe*).

Of the parents in the traditional neighborhood, 35 percent find the physical environment *fairly safe* and 65 percent find it *very safe*. There was a difference in the distribution between parents of boys and girls whereas 44 percent of girls' parents find the physical environment *fairly safe* and 56 percent *very safe* but 14 percent of parents of boys consider it *fairly safe* and 86 percent *very safe*. The average further underscores this difference: 2.6 (falls between *fairly safe* and *very safe*) for parents of girls and 2.9 for parents of boys (falls closer to *very safe*). The mean for the neighborhood was 2.7 (falls between *fairly safe* and *very safe*). In the co-housing community, all of girls' parents consider the neighborhood *very safe* in terms of physical safety and 75 percent of boys' parents. The mean for the neighborhood was 2.6 (falls between *fairly safe* and *very safe*).

Thus, parents in the co-housing community consider their neighborhood safer (83% *very safe*) in terms of physical safety than the parents in the traditional (65%) mixed-use (59%) neighborhoods. The average outcome measure for the three neighborhoods was however similar; 2.6 in the mixed-use neighborhood, 2.7 in the traditional neighborhood, and 2.8 in the co-housing neighborhood (falls between *fairly safe* and *very safe*). No parents consider their neighborhood *not safe*. Parents' of girls in the mixed-use and traditional neighborhoods seem to fear more for their child's physical safety than parents of boys or +28 percent in the mixed-use and +28 percent in the traditional.

Parents' Perception towards Children's Social Safety

Of the 29 parents in the mixed-use neighborhood, 48 percent find the social environment *very safe*, 45 percent find it *fairly safe*, and 7 percent *not safe*. The mean for the neighborhood was 2.4 (falls between *fairly safe* and *very safe*). There was a difference in the distribution between parents of boys and girls whereas 45 percent of parents of girls find the social environment *very safe* and 56 percent of parents of boys. Of girls' parents, 10 percent find the social environment *not safe*. As shown in table 18c, the average further underscores this difference: 2.4 (falls between *fairly safe* and *very safe*) for parents of girls and 2.6 for parents of boys (falls closer to *very safe*).

Of the 23 parents in the traditional neighborhood, 39 percent find the social environment *fairly safe* and 61 percent *very safe*. The mean for the neighborhood was 2.6 (falls between *fairly safe* and *very safe*). There was a considerable difference in the distribution between parents of boys and

girls whereas 44 percent of girls' parents find the social environment *fairly safe* and 56 percent *very safe* but 29 percent of parents of boys consider it *fairly safe* and 71 percent *very safe*. The average for parents' of girls and boys was similar (2.6 and 2.7 falls between *fairly safe* and *very safe*).

All six parents in the co-housing neighborhood find the social environment *very safe*. The mean for the neighborhood was 3.0 (*very safe*).

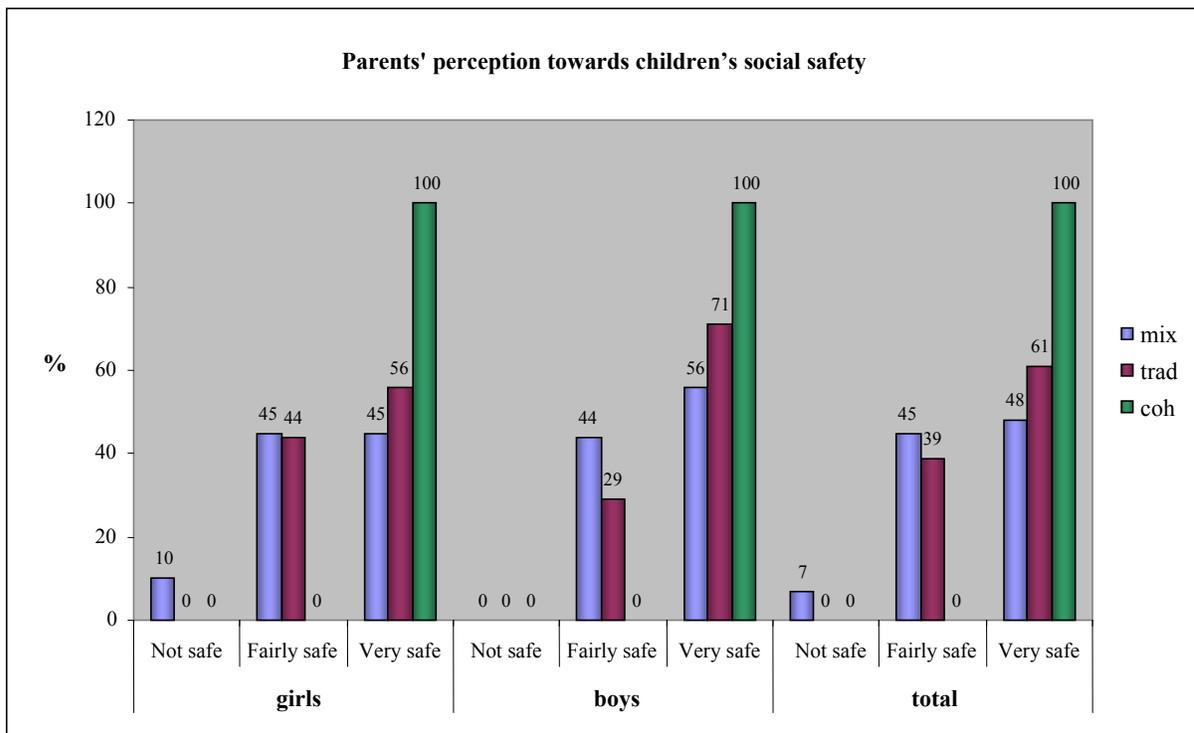


Figure 51: Parent's perception towards children's social safety

4.3.5 Summary of Findings for Children's Mobility

The children in the mixed-use neighborhood recorded 1.0 more *non-localized* and *linear settings* per day than those in the traditional and co-housing neighborhoods. On schooldays, this type of activity accounted for roughly half of the *lifestyle activities* in the mixed-use neighborhood, about 1/4 in the traditional, and only 1/10 in the co-housing category. The distribution on weekends was similar for the traditional and co-housing neighborhoods, but less in the mixed-use category. The boys recorded more activity/settings per day than the girls in all three neighborhoods.

Almost all of the linear settings used in the mixed-use neighborhood were *formal paths*, 3/4 in the co-housing community, but less than half in the traditional neighborhood. About a quarter of the

settings in the co-housing community were *primary and secondary streets*, and about half of the settings in the traditional category (80% of the linear settings used by the boys).

The distance traveled further underscores the above neighborhood difference; the children in the mixed-use neighborhood traveled greater distances than those in the other two categories, or roughly half a mile per day. The distribution on schooldays and weekends in the mixed-use and traditional neighborhoods was similar, but in the co-housing community, they traveled greater distances on schooldays than weekends. The children in the mixed-use neighborhood also traveled the furthest without an adult. The three children in the co-housing community had not traveled further than 1000 feet from their home. The boys traveled greater distances than girls. Also of note was that 50 percent of the boys in the traditional neighborhood had explored further than 4000 feet.

These findings were supported by the findings from the parental questionnaire, where most of the parents in the mixed-use and co-housing neighborhood stated that their child walks or cycles to school at least one way on a regular basis but none of the parents in the traditional neighborhood.

The parents were also asked about the distance their child walks or bikes to and from school. The children in the co-housing neighborhood travel approximately the same distance or $\frac{1}{4}$ to $\frac{1}{2}$ mile one way but the distance traveled in the mixed-use neighborhood varies more ranging from $\frac{1}{4}$ mile or less to $\frac{1}{2}$ mile or more. Thus, the findings also show a relationship between the school's walkability and the distances traveled (and thus physical activity). This relationship was especially clear in the findings for the co-housing neighborhood where the children traveled 0.4 more miles/day further on schooldays than weekends.

The findings for physical safety were similar. Parents in the co-housing community find their neighborhood more physically safe than the parents in the traditional neighborhood (+18%) and mixed-use (+24%). They also find their neighborhood more socially safe than the parents in the traditional neighborhood (+39%) and the mixed-use neighborhood (+52%).

The average for the mixed-use neighborhood was 2.4 (falls between *fairly safe* and *very safe*), 2.6 in the traditional (falls between *fairly safe* and *very safe*), and 3.0 in the co-housing community neighborhood (*very safe*). The greatest difference was found in the distribution by gender whereas parents' of girls in the mixed-use and traditional neighborhoods seem to fear more for their child's physical safety than parents of boys or 11 percent more in the mixed-use and 15 percent in the traditional.

4.4 Children’s Favorite Places

In the activity log, the children were asked to mark in their favorite places in the neighborhood. In the co-housing neighborhood only one boy reported on his favorite place. Tracking favorite places was also one of the main objectives in the child-led fieldtrips.

4.4.1 Favorite Places in the Mixed-use Neighborhood

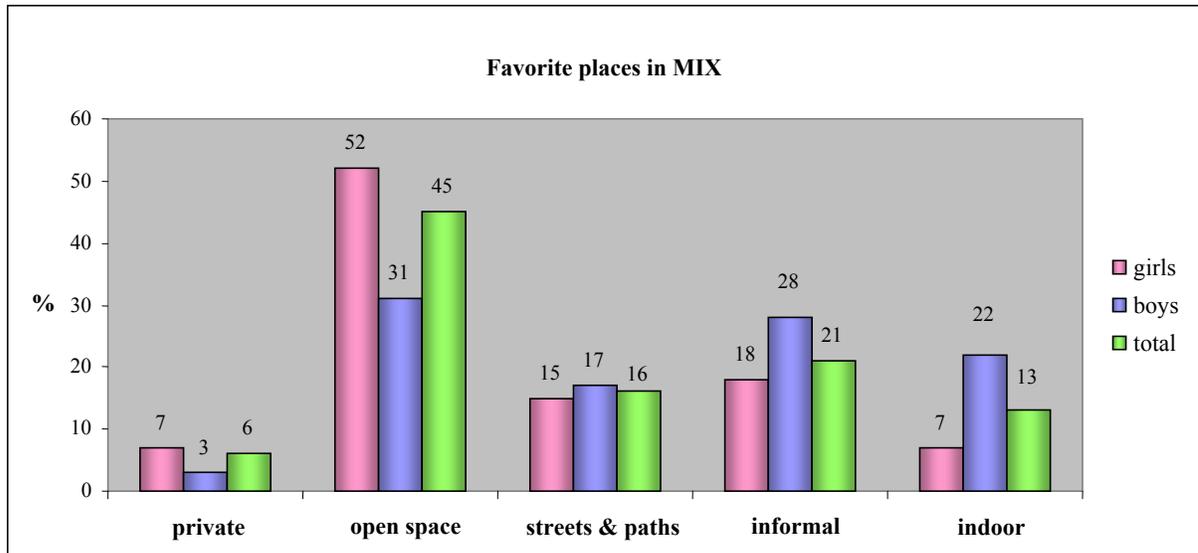


Figure 52: Favorite places in the mixed-use neighborhood

As shown in table 17b, 16 types of settings were recorded as favorite places by the 19 respondents in the mixed-use neighborhood. The average number of settings was 5.4 settings/child. Four children did not specify a favorite place, but the highest number mentioned was eleven. Of the settings most frequently recorded 45 percent were *formal open spaces* (43% parks and formal play areas, 37% the swimming pool, 11% recreation and sports fields, and 9% school grounds), 21 percent *informal settings* (55% natural areas w/ water, 23% natural areas, and 18% other), 16 percent *streets and formal paths* (44% tertiary streets (back alleys and cul-de-sacs), 31% formal paths, and 19% primary and secondary streets), 13 percent *indoor facilities* (77% movie theater), and 6 percent were *private settings* (83% child’s own yard).

The main gender differences were that the girls recorded three more types of settings than the boys although the average number of settings was 0.8 settings/child higher for the boys. The girls

favor *formal open spaces* (+21%) more than the boys who favor *informal settings more* (+10%) and *indoor facilities* (+15%) more than the girls. The mentioning of *streets and formal paths* was similar.



Figure 53: Children's most favorite places in the mixed-use neighborhood

4.4.2 Favorite Places in the Traditional Neighborhood

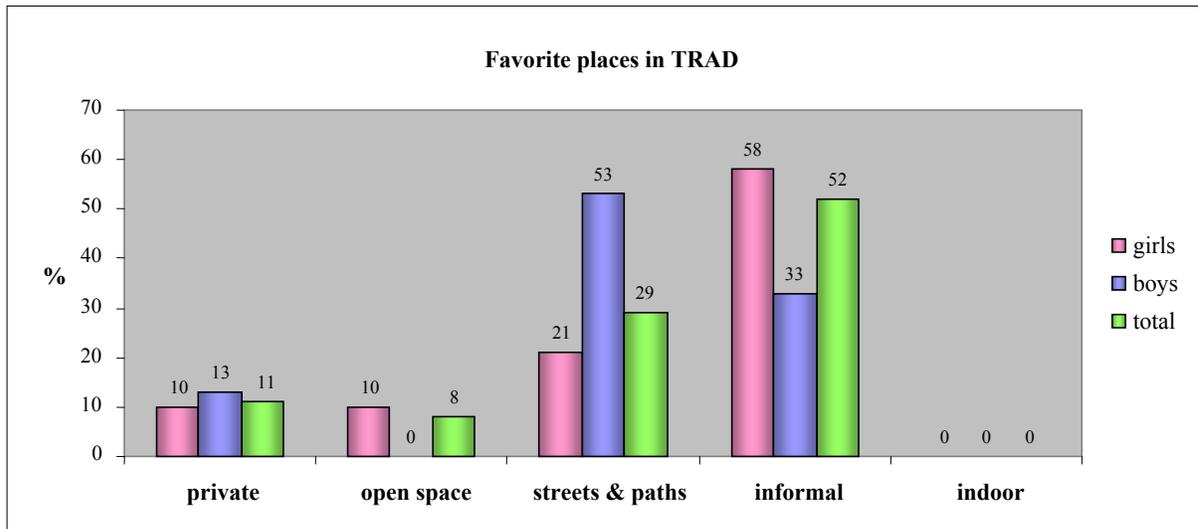


Figure 54: Favorite places in the traditional neighborhood

As shown in table 17b, thirteen types of settings, were recorded as favorite places by the 19 respondents in the traditional neighborhood. The average number of settings was 3.3 settings/child. The lowest number of places mentioned was zero and the highest was five. Of the types of settings recorded 52 percent were *informal settings* (48% natural areas and 42% natural areas w/water), 29 percent *streets and formal paths* (33% tertiary streets (cul-de-sacs), 28% railroad tracks, 22% primary and secondary streets, 17% streets good for sledding, and 17% formal paths), 11 percent *private settings* (71% friends' yards and 29% child's own yard), and 8% *formal open space* (all parks and formal play areas). All of the places mentioned were outdoor settings.

The main gender differences were that the girls recorded four more types of settings than the boys and 0.4 settings/child more than the boys. *Formal open spaces* were only mentioned by the girls. They also favor *informal settings* more than the boys (+25%), whereas the boys favor *streets and formal paths* more than the girls (+32%). The distribution of *private settings* was similar.

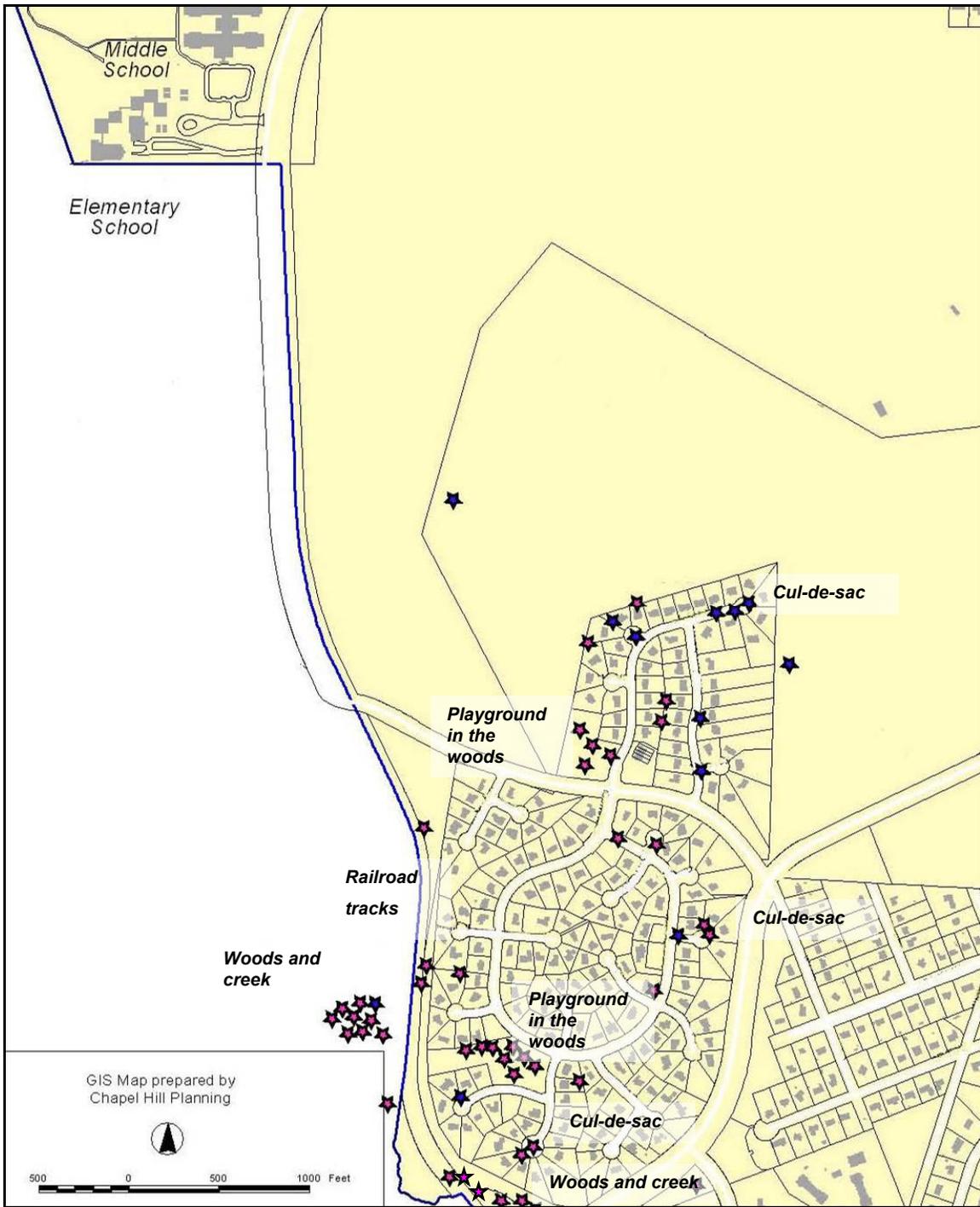


Figure 55: Children's most favorite places in the traditional neighborhood

4.4.3 Comparing Favorite Places in the Two Neighborhoods

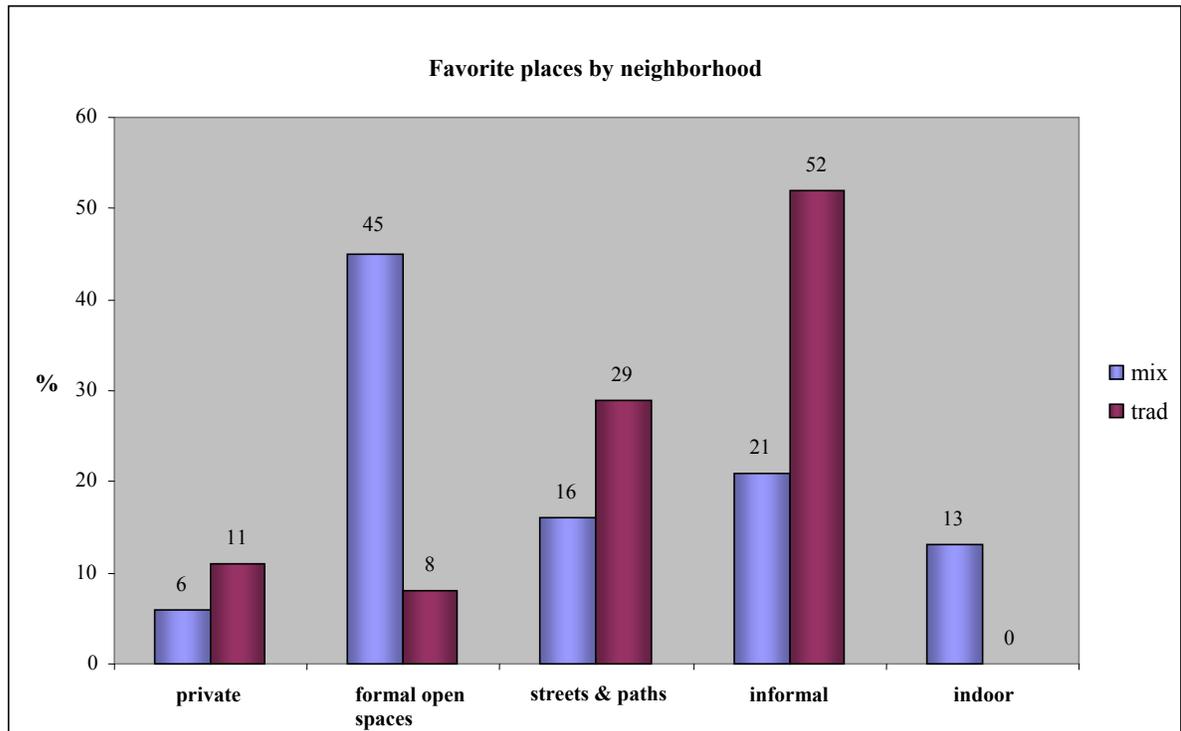


Figure 56: Comparing favorite places by neighborhood

The children in the mixed-use neighborhood recorded 37 percent more *formal open spaces* and 13 percent more *indoor facilities* than those in the traditional neighborhood, who, recorded 13 percent more *streets and formal paths*, 5 percent more *private settings*, and 31 percent *informal settings*.

This difference was also reflected in the distribution by gender. The girls in the mixed-use neighborhood were 42 percent more attracted to *formal open spaces*, 6 percent more to *streets and formal paths*, and 7 percent more to *indoor facilities* than those in the traditional neighborhood, who were 14 percent more attracted to *private settings* and 40 percent more to *informal settings*. The boys in the mixed-use neighborhood favored *formal open spaces* (+31%) and *indoor facilities* (+22%) more than those in the traditional neighborhood, who, on the other hand, favored *private settings* (+10%), *streets and formal paths* (+36%), and *informal settings* (+5%) more. The girls in both neighborhoods were more attracted to *open space* than the boys who favored *streets and paths* more than the girls, especially the boys in the traditional neighborhood. Also noteworthy was the popularity of *informal settings* by the girls in the traditional neighborhood.

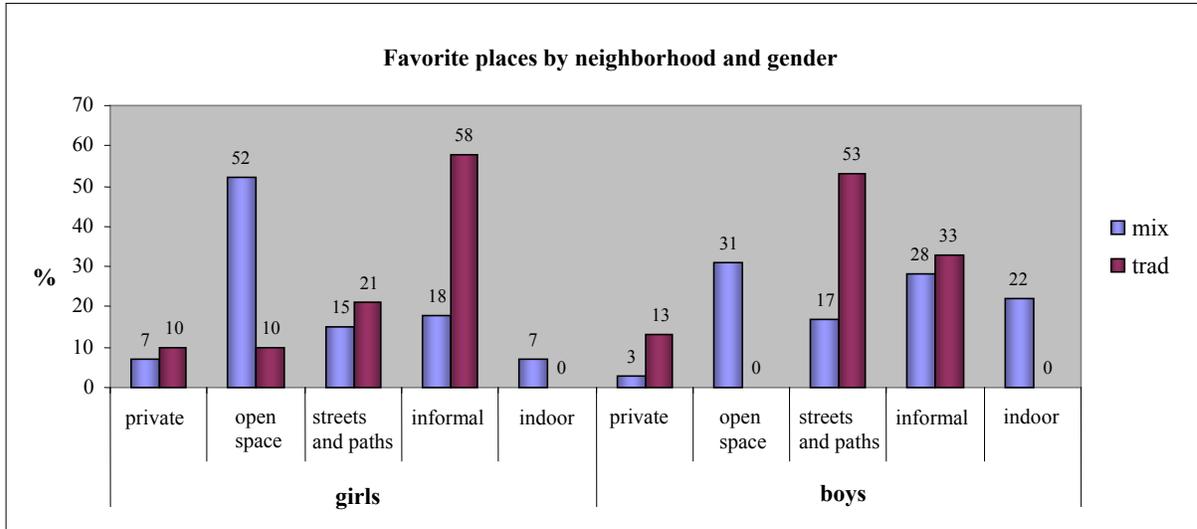


Figure 57: Comparing favorite places by neighborhood and gender

As shown in table 17b, this difference was also reflected in the number of types of favorite places. The children in the mixed-use neighborhood recorded three more types of favorite places and the average number of favorite places was also higher (2.1 settings/child) than in the traditional neighborhood. This was true for the girls and the boys. Although the girls in the mixed-use neighborhood recorded more places and more categories of places, the boys recorded 0.9 more settings/child than the girls, which was especially noteworthy because the girls were twice the number of boys. Only one child in the co-housing neighborhood participated in this part of the research. His favorite place was the neighborhood playground.

4.4.4 Extracts from Child-led Fieldtrips

The activity log was followed-up with a child-led fieldtrip including an open-ended interview. The interview was conducted in order to explore other possible contextual influences and to get a more holistic picture of children's use of their home environment, the physical activities they are engaged in, and their favorite places. Summaries from the fieldtrip narratives are presented in appendix I. Seventeen children were selected from the three neighborhoods (nine girls and eight boys); eight from the mixed-use neighborhood, six from the traditional, and three from the co-housing community.

Fieldtrips in the Mixed-use Neighborhood

Eight children from the mixed-use neighborhood (four girls and four boys) participated in this part of the research. They all described a rich environment with many places of interest, and appeared relatively free to roam around the neighborhood. They use the opportunity when walking to and from school to play and explore places along the way, both planned places such as playgrounds and natural places such as woods and creeks. The girls seem to be more drawn to private settings such as back yards than the boys. Both the boys and the girls mentioned a variety of formal places, such as the school grounds (ball fields), parks and playgrounds, and the community swimming pool as places of interest. The boys seem to like streets and associated settings more than the girls. Informal settings were also very popular, especially the woods and creeks, where children go in search of adventure. A further attraction in these settings is the attendant wildlife. Some also mentioned forts and tree houses in the woods as places of attraction. In general parents seem to have concerns about their child's safety when playing in natural areas, especially the parents of girls. The girls tend to play in smaller settings such as forts and enclosures, and enjoy seeking things out, whereas the boys prefer more expansive play environments such as the pond locality and the tunnel/creek for adventure games.



Photo 1: The sidewalks are heavily used



Photo 2: The boys like the streets



Photo 3: Boys are attracted to the movie theater



Photo 4: The swimming pool is a popular place



Photo 5: The “concrete thin” is a stage for pretend games



Photo 6: Ponds are fun places



Photo 7: The “island” is also a stage for pretend play



Photo 8: The “tunnel” (water tunnel underneath a bridge) is a favorite place of many children



Photo 9: The “tunnel” is a hiding spot where many adventures take place



Photo 10: The rocks by the greenway are heavily used



Photo 11: Street corners are desirable places sell things



Photo 12: Paved surfaces are for many uses - chalking



Photo 13: Many girls notice flowers and boys collect twigs



Photo 14: “The alley is our playground”



Photo 15: Many children like play equipment



Photo 16: but it is too small!



Photo 17: The way down to the creek shows signs of heavy usage



Photo 18: The old graveyard attracts many children



Photo 19: It feels like flying when standing on the big rock



Photo 20: Large lawns are good for ball play



Photo 21: The woods are a world of its own!



Photo 22: There are many “tree houses” in the woods



Photo 23: and caves too!



Photo 24: The kids claim territories in the woods

Fieldtrips in the Traditional Neighborhood

Six children from the traditional neighborhood (four girls and two boys) participated. Two of the girls were asked to participate because they had reported little interest in the outdoor environment. Most of the children use the large back yards to play. They also walk or ride around the neighborhood to friends' houses. The cul-de-sacs are popular places to play group-games and ball-games, although they are not designed for play. Playing in the woods is also popular, but most children are not allowed to go there alone, and some are not allowed to go there unless accompanied by an adult. This was especially true for the girls. The boys seem much freer to roam around the neighborhood and the surrounding woods than the girls. There are two playgrounds in the neighborhood, one on each side. Both are located in wooded areas not visible from the street. Interestingly, the children do not seem interested in

playing there and some are not allowed to play there. The woods constitute a very rich play environment with many places of interest. The girls seemed more interested in collecting things such as flowers, shells and man-made objects in smaller areas, but the boys circulate around the neighborhood to a greater degree, and use the woods more actively for games such as jumping in the creek, climbing rocks and mountain-biking along the dirt paths.



Photo 25: cul-de-sacs are popular for games



Photo 26: They like quiet places for meditation



Photo 27: Many girls like private yards



Photo 28: Many boys prefer the woods



Photo 29: The railroad track are attracting



Photo 30: The teens hang out here



Photo 31: A secret place



Photo 32: Big rock to watch the territory



Photo 33: The playgrounds are not visible from homes or streets



Photo 34: The cancer tree



Photo 35: Bike ramps in the woods



Photo 36: Mountain bike trail



Photo 37: There we jump into the stream

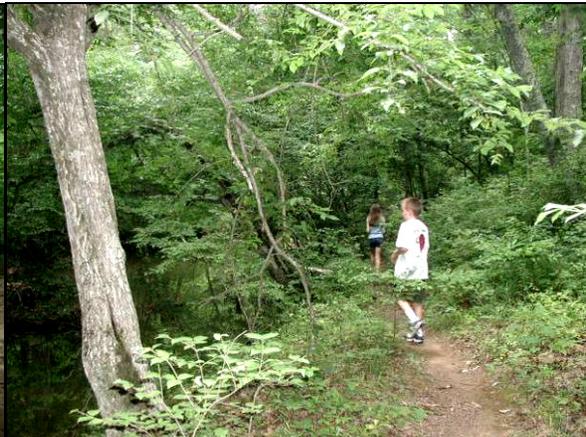


Photo 38: Nice paths but I don't go there a lot



Photo 39: Girls like to collect things in the woods



Photo 40: This is my favorite tree



Photo 41: The construction area is exciting



Photo 42: We play in the island but the shrubs scratch



Photo 43: I like the flowers in my friend's yard



Photo 44: Play with swords (dried daylily sticks)

Fieldtrips in the Co-housing Neighborhood

Only three children participated in the co-housing neighborhood, two boys and one girl. The four children who participated in the log were asked if they would like to participate in this part of the study. One could not be reached. The girl was actually too old for this study, but since she had lived in the neighborhood for several years, and knew it well, she was asked to come along with her younger brother. This was also the case with the third participant. All of them were enthusiastic to show the researcher around, and during the course of the fieldtrips they pointed out a number of enlightening things, but because the boys were only eight years old, different restrictions came into play which makes any neighborhood comparisons difficult. Nevertheless, the extracts from the fieldtrips provide thorough descriptions of the neighborhood.

The most striking findings, although not surprising, were that children's individual characteristics require a wide variety of opportunities for play, and that it is very likely that the size of the neighborhood greatly affects the exploration range. As stated by one of the participants, the neighborhood has many interesting destinations for children this age but as they mature there are fewer places of interest and they explore places further away, for instance walking the trails and building forts in the surrounding woods. The most used setting (researcher's observations) was the hard-surfaced path inside the neighborhood. The children use it for wheeled activities, to go places, and for active games. The playground, although small, is very popular. There the children can use the play equipment provided, but also make up their own games. It is also a meeting place. The children in this neighborhood have a good sense of neighborhood boundaries and parental restrictions, but their exploration range is very small.



Photo 45: Children like water play



Photo 46: Along the path are many features of interest



Photo 47: The children showed little interest in the community garden



Photo 48: Children like secluded spaces



Photo 49: The circular path for wheeled activities



Photo 50: The pond is off limits unless accompanied by an adult



Photo 51: Informal settings for creative play



Photo 52: Path to school



Photo 53: The play equipment for younger kids but they use it differently



Photo 54: The basketball hoop are for older kids



Photo 55: Hammock for games

Photo 56: Play in shade

Photo 57: Small and badly maintained ball field

4.4.5 Summary of Findings for Favorite Places

Roughly half of the settings recorded in the traditional neighborhood were *informal settings* but *streets and formal paths* and *private settings* were also popular. In the mixed-use neighborhood almost half of the settings recorded were *formal open spaces*, but *informal spaces* and *streets and formal paths* were also frequently mentioned. The most noteworthy gender differences were that the girls in both neighborhoods are more attracted to *formal open spaces* than the boys. *Streets and paths* were popular among the boys in the traditional neighborhood but *indoor settings* among the boys in the mixed-use neighborhood. Also noteworthy was the popularity of *informal settings* by girls in the traditional neighborhood. The children in the co-housing community did not participate in this part of the research.

The key findings from the child-led fieldtrips largely support those from the children's activity log. In the mixed-use neighborhood the importance of the school's walkability in terms of opportunities for free play activities en route are appreciated by the children. The girls are more inclined to stay around the homes and prefer smaller formal open spaces, whereas the boys seem to wander more freely and prefer larger open spaces and indoor facilities, such as the movie theater. Both girls and boys are very attracted to natural areas. In the traditional neighborhood, the children enjoy the large back yards and cul-de-sacs. The girls tend to stay more around the homes but the boys are more free-ranging and like to explore. They are very attracted to the woods and the inherent mystery element of the woodland environment. The girls go there to collect things but the boys seem to look for adventures. The use of the woods in the traditional neighborhood seems however, more off-limits than in the mixed-use neighborhood, and the children in the co-housing neighborhood

rarely go beyond the neighborhood “boundaries.” This group mostly stays within the formal open space between the houses, and is enthusiastically drawn to the small playground and the circular hard-surfaced paths inside the neighborhood.



5 Discussion

The purpose of this study was to examine the relationships between neighborhood morphology and children's physical activities. This research is theoretically driven using theories in the field of Environment and Behavior especially Roger Barker's (1968) Behavior Settings Theory, James J. Gibson's (1979) Affordance Theory, Harry Heft's (1988) functional approach of identifying physical properties supportive of children's activities, and Urie Bronfenbrenner's Ecological Systems.

Based on a review of neighborhood research literature, it was expected that the level of children's physical activities would be higher in the "mixed-use" neighborhood, intermediate in the "co-housing" neighborhood, and lower in the "traditional" neighborhood. The following discussion is framed by the four primary research questions of the study: what is the relationship between neighborhood morphology and (i) types of outdoor, out-of-school, physical activities children engage in, (ii) types of physical settings children seek, (iii) children's mobility, and (iv) children's most favorite places?

5.1 Children's Engagement in Physical Activities

The first research question focused on the relationship between neighborhood morphology and the types of outdoor, out-of-school physical activities children engage in. As expected, the children in the mixed-use and co-housing neighborhoods were engaged in more physical activities within their neighborhood than those in the traditional neighborhood, who, on the other hand, recorded more activities outside their neighborhood and were thus more dependent on automobile use.

Nearly all of the activities recorded within the three neighborhoods were lifestyle activities. When scrutinizing the data set, a difference by neighborhood and gender was found, especially in the distribution of active play and travel between places, the most commonly recorded types of activities. The children in the co-housing and traditional neighborhoods recorded proportionally more localized active play whereas the distribution in the mixed-use neighborhood was more even among the

categories underscoring the relationship between neighborhood affordances in terms of provision of activity supporting linear settings. The findings also revealed a difference by gender, with boys being more active than girls, supporting results from previous research. The gender difference raises questions about gender activity patterns in general and their relationship to neighborhood affordances.

The low engagement in nature activities was unexpected because this type of activity is highly rated in the research literature for its importance to healthy development. The findings for weekends were especially noteworthy because children usually have more free time then and are allowed to stay outside longer. The findings from the child-led fieldtrips, however, disclosed a different pattern in which natural settings ranked high as favorite places as discussed in the following section on favorite places. The results suggest that it is likely that such activities take place infrequently and are connected to seasonal periods, which may explain why they rarely appeared in the activity logs. Several other reasons such as neighborhood layout, proximity to natural areas, and lack of time, fear, and parental restrictions may have affected children's engagement in nature activities, an interpretation supported by data from the parental questionnaire and child-led fieldtrips. Overall, the findings were consistent with the expectation that neighborhood affordances influence children's engagement in physical activities.

5.1.1 Children's Engagement in Organized Physical Activities

A sub-question of the first research question focused on the relationship between neighborhood morphology and children's engagement in organized physical activities. The low rate of this type of activity within the neighborhoods (1%), as reported in the activity log, was unexpected particularly in the mixed-use neighborhood because the neighborhood has several sport and recreational facilities such as a swimming-pool, ball fields, tennis courts, beach volleyball field and school grounds with ball fields and a basketball court. Results from the parental survey in the mixed-use neighborhood, however, contradicted the findings from the children's logs. There, the parents stated that about half of the children were involved in organized activities on regular basis within the neighborhood. The difference between the results from the activity logs and parental survey may partially be explained by the timing of the log data collection; the season was over for "winter" activities with "summer" activities such as swim team were about to start. This may have affected the log data as it was limited to the current week whereas the parent survey collected data on activities children engage in on a regular basis.

The findings from the activity logs also revealed that around 70 percent of the total child population was involved in organized out-of-neighborhood activities, especially the children in the traditional neighborhood (91%). The fact that fewer children in the mixed-use neighborhood (59%) engage in organized, out-of-neighborhood, physical activities than in the traditional supports the findings from the parental questionnaire in the mixed-use neighborhood. Thus, neighborhoods that have sport and recreational facilities are more supportive of children's physical activities and children who live in neighborhoods without such facilities are more dependent on out-of-neighborhood activities and associated shuttling by parents.

5.2 Physical Settings Children Seek

The second research question focused on the relationship between neighborhood morphology and types of physical settings children seek. Not only does the physical neighborhood environment seem to affect the number and types of physical activities but also where they take place. Almost 90 percent of the activities in the mixed-use and co-housing neighborhoods took place within the neighborhood, but only about 60 percent of the activities in the traditional neighborhood. The differences were also marked by the variety of types of settings; 18 in the mixed-use compared to 13 in the traditional. Although there were only 4 participants in the co-housing community, the high variety of types of settings (11) was unexpected, especially due to the neighborhood's small size.

The activities in the traditional neighborhood mostly took place around the homes and in the cul-de-sacs. The children in the co-housing community mostly used the pedestrian paths and playground on the inside of the neighborhood and the streets and sidewalks on their way to school. As with the variety of children's activities, the settings used in the mixed-use neighborhood were more varied than in the other two neighborhoods. Children used formal open spaces such as playgrounds and parks often and the swimming pool was also frequently visited. To get around they mostly used formal paths and tertiary streets such as back-alleys. Indoor settings were also one of the most regular destinations. On schooldays, the school as a point of destination for trip by foot or bike was prominent but on weekends the movie theater was the center of attraction. The greater use of private settings in the traditional neighborhood and public open space in the mixed-use was especially noteworthy and further emphasizes a relationship between neighborhood morphology in terms of availability of public outdoor settings and children's physical activities.

The findings for the variety of types of settings children seek suggest an association between neighborhood morphology and children's physical activities. The low engagement in nature activities and low use of nature settings was however an exception from this general pattern because all three neighborhoods had seemingly good access to a variety of natural areas. Although the children in the three neighborhoods rarely engaged in nature activities, as discussed above, many of them did cut across smaller natural areas and some showed patterns of following the edge of development when going places. This was especially true for the mixed-use neighborhood. These findings underscore the relationship between neighborhood morphology, in terms of integration of natural settings into the built environment, and children's physical activities. The homes in the traditional neighborhood had large back yards adjacent to woods whereas the homes in the mixed-use neighborhood were more clustered and only a few provided direct accesses to natural areas. This may in fact, explain why children in the traditional neighborhood recorded more nature activities. Also, the fact that most of the children in the mixed-use neighborhood preferred to use the greenway instead of sidewalks on their way to school may indicate a preference for nature connection. Thus, there seems to be a connection between neighborhood affordances in terms of neighborhood layout and access to natural areas and nature activities. If children need contact with nature, as is suggested by the literature, it is necessary to provide them with opportunities that enable direct contact with nature such as commonly used paths that run along or cut through nature corridors.

5.2.1 Perception of Opportunities for Children's Outdoor Physical Activities

A sub-question of the second research question focused on the relationship between neighborhood morphology and parents' perception of opportunities for children's outdoor physical activities. The findings showed that 82 percent of parents in the mixed-use neighborhood and all six in the co-housing community found their neighborhood very good in this regard compared to only 35 percent the traditional locality. The findings were as expected for the traditional and mixed-use neighborhoods, but higher than expected for the co-housing neighborhood, especially due to its small size, limited connectivity to nearby neighborhoods, and lack of facilities for this age group. Parents' view of neighborhood quality may provide important indicators of neighborhood affordances for children's physical activities especially as encouragement may play an important role in children's use of the outdoors for physical activity suggested by Baranowski et al. (1993). Another interesting finding was that 75 percent of the parents' of girls in the traditional neighborhood consider opportunities for children's outdoor activities only fair but 86 percent of parents of boys think of it as

very good. These findings support speculations that the neighborhood does not afford enough opportunities for activities of interest to girls and raises questions about gender activity patterns in general and their relationship to neighborhood affordances.

5.3 Children's Mobility

The third research question focused on the relationship between neighborhood morphology and children's mobility. The question was divided into four sub-questions.

5.3.1 Children's Non-localized Physical Activities

The first sub-question focused on the association between neighborhood morphology and types of non-localized, outdoor, out-of-school, neighborhood physical activities in which children engaged. The children in the mixed-use neighborhood were up to 40 percent more engaged in this type of activity than the children in the other two neighborhoods. The findings were as expected since the mixed-use neighborhood offered a more advanced pedestrian path-system. As with other activity data, boys used this type of activity more than girls. Thus, neighborhood affordances in terms of linear settings influenced children's non-localized physical activities and thus their mobility.

The characteristics of this type of activity were also different, especially on schooldays. As expected, the findings for the mixed-use neighborhood showed higher associations than the other two neighborhoods. In fact, non-localized activities on schooldays counted for about half of the *lifestyle activities* in the mixed-use neighborhood compared to 27 percent in the traditional neighborhood and only 10 percent in the co-housing neighborhood. This difference confirms the fact that the school's walkability is an important determinant for children's physical activities.

5.3.2 Children's Use of Linear Settings

The second sub-question focused on the relationship between neighborhood morphology and the types of linear settings children seek for non-localized physical activities. The findings revealed that children in the mixed-use neighborhoods used formal paths such as sidewalks and greenways more than those in the traditional neighborhood, who, on the other hand mostly used *streets* when going

places. Thus, children choose to use pedestrian paths when provided for which is important because pedestrian paths are much safer settings than streets. The findings for the co-housing neighborhood were noteworthy because it was expected that the internal path system would encourage children to go places. Although the path system was not used much as a medium to go places, it was nevertheless a common point of destination in itself. Thus, the small size of the neighborhood and, consequently, fewer points of destinations, may explain this. Another interesting finding when scrutinizing the mapping of children's routes in the mixed-use neighborhood in connection to localized settings used was the fact that on their way to and from school they frequently stopped at settings along the way. These findings were supported by the fieldtrips data. The settings were for example small playgrounds, rocks, and access paths to the creek along the greenway. Accordingly, such settings along heavily used paths are therefore important physical activity stimulators.

5.3.3 Distances Children Travel

The third sub-question focused on the relationship between neighborhood morphology and the distances children travel by foot or bike within the neighborhood. The results from the behavior mapping in the activity logs showed that children in the mixed-use neighborhood traveled greater distances than children in the other two neighborhoods, roughly half a mile per day.

The findings from the mapping of activity locations also suggest that the size of the built area may be an important indicator of physical activity, especially mobility, as the children rarely left the perimeter of the built environment. Thus, the edge of the built environment seems to act as a boundary for children and as a restriction imposed by parents. The findings from the activity log also showed that the road that runs through the traditional neighborhood hinders children's mobility in that the children do not and are not allowed to cross the road unless accompanied by an adult. In fact, the children on either side of the road have minimal contact (log data showing the location of the participants' friends' homes and data from field-trips). Thus, neighborhood morphology seems to influence distances traveled within the neighborhood.

5.3.4 Distances Traveled To and From School

As it is believed that the location of the school may be an indicator of children's physical activity, the fourth sub-question focused on the relationship between neighborhood morphology and distances children travel by foot or bike to and from school.

As discussed here above, the findings for the mixed-use neighborhood showed higher associations between neighborhood morphology and the frequency of non-localized physical activities than the other two neighborhoods, especially on schooldays. The findings were not surprising because the school in the mixed-use neighborhood is located within the neighborhood and highly walk/bike-able (about 0.1-1 mile). The low association in the co-housing community was somewhat surprising because even though the school is outside the neighborhood one would expect that it would be considered walkable (about 0.6-0.7 mile). The school the children attended in the traditional neighborhood is located outside the neighborhood (about 1-1.5 mile) and not easily accessible by foot or bike. It would normally be considered a “bike-able” distance for nine to eleven year olds if the path system would be designed to afford this type of activity. This difference underscores the fact that the school’s walkability plays an important role in children’s lives.

Although the results from the behavior mapping in the activity logs showed that the distances traveled was the highest in the mixed-use neighborhood, roughly half a mile per day, the children in all three neighborhoods were more mobile on schooldays. The difference between schooldays and weekends in the co-housing community was especially interesting as the children traveled on average 0.4 miles/day greater distances on schooldays. The findings further underscore the importance of school’s walkability. Thus, neighborhood differences can largely be explained by the affordances in terms of the school’s walkability or in the case of the traditional neighborhood, the distances to and from the bus stop. Furthermore, the fact that the distances traveled on schooldays and weekends in the mixed-use neighborhood also give support to speculation that a greater variety of appropriate and walkable neighborhood settings, including schools, play areas, and swimming pool, spread over a larger area, encourages children’s non-localized mobility.

Parents were also asked about the distance their child walked or biked to and from school on a regular basis. Due to the small size of the co-housing neighborhood, the children traveled approximately the same distance, $\frac{1}{4}$ to $\frac{1}{2}$ mile one way, but the distance traveled in the mixed-use neighborhood varied from $\frac{1}{4}$ to $\frac{1}{2}$ mile or more. Interestingly, the findings from the parents’ questionnaire contradicted the findings from the activity logs. Almost all of the parents in the mixed-use neighborhood and the co-housing community stated that their child walked or biked at least one way to school on regular basis, none did so in the traditional neighborhood. It is likely that the differences in responses from the two data collection methods are related to changes in activity patterns during the school year and the fact that the parents were asked about walking/biking to school on regular basis whereas the activity log only covered nine days. The findings for the traditional neighborhood were in consonance with findings from the South Carolina Coastal

Conservation League Survey (1999) in which only four percent of students attending schools built after 1983 walked to school and children who lived within 1.5 miles used school buses. The findings from the activity log and the parental survey therefore support the notion that the walkability of the school is an important indicator for children's physical activity.

5.3.5 Parents' Perception of Children's Safety

The fifth sub-question focused on the relationship between neighborhood morphology and parents' perception of neighborhood quality in terms of children's physical and social safety. The findings revealed that the parents in the co-housing community find their neighborhood safer than the parents in the other two neighborhoods, especially those in the mixed-use neighborhood. As far as the physical environment goes there may be several contributing street design factors such as (i) number of access streets; one in the co-housing, two in the traditional, and three in the mixed-use, and (ii) number of street intersections; 70 in the mixed-use, 16 in the traditional and none in the co-housing. The fact that the inside of the co-housing neighborhood is free of automobiles and that there is good visibility from the houses may also contribute to parents' sense of safety. The thoroughfare road that cuts through the traditional neighborhood severely restricted children's traveling range. Other contributing factors may be: (i) the geographical (and population) size of the built neighborhood environment; 270 acres in the mixed-use, 84 in the traditional, and three in the co-housing, (ii) the size of private lots; $\frac{1}{4}$ acre or less in the mixed-use and co-housing neighborhood and $\frac{1}{2}$ to $\frac{3}{4}$ acre in the traditional, and (iii) availability of public open space settings. It is likely that these morphological factors are associated with parental concerns about safety and children's mobility.

The findings also revealed that parents of girls in the mixed-use and traditional neighborhood were more afraid for their child's physical and social safety than parents of boys. During a log review, some of the parents of girls stated that even though they lived within walkable distance from the school, they drive their child to and from school due to safety reasons. No specific reasons were found explaining why parents of girls thought the physical environment is less safe than parents of boys.

5.4 Children's Favorite Places

The fourth research question focused on the relationship between neighborhood morphology and children's most favorite places within the neighborhood. Although the findings from the physical activity data showed that children rarely engaged in nature activities and rarely crossed the boundaries of the built environment, more than half of the favorite places recorded in the traditional neighborhood and a quarter of the favorite places in the mixed-use neighborhood were natural areas. As with the findings from the other sections, there was a higher association between neighborhood morphology and number and variety of types of favorite places in the mixed-use than the traditional neighborhood.

The second most popular type of setting in the traditional neighborhood was *streets and formal paths*, particularly cul-de-sacs, but *private settings* such as yards were also frequently mentioned. The most commonly mentioned type of favorite places in the mixed-use neighborhood was *formal open spaces*, mainly parks, playground and the swimming pool. *Informal settings* was the second most popular type of settings in the mixed-use neighborhood but many children also mentioned *streets and formal paths*, particularly cul-de-sacs and back-alleys and *indoor settings* such as the movie theater.

The findings from the child-led fieldtrips mostly supported those from the activity logs. Girls tended to stay in the vicinity of the homes and were attracted to smaller formal settings such as playgrounds, and natural areas whereas the boys roamed further from the homes, played in larger spaces, and explored natural areas. *Natural areas* with water such as creeks and ponds were popular as favorite places. The popularity of the tunnel underneath a bridge in the mixed-use neighborhood as a place for imaginary play was particularly noteworthy. The distribution of *formal open spaces* such as playgrounds and smaller parks in the vicinity of homes in the mixed-use neighborhood appears important to girls and more consideration should be given to the needs of girls this age in the selection of equipment in the design of playgrounds. Interestingly, girls in the traditional neighborhood were less attracted to the two play areas in the neighborhood, the main reasons being that some parents would not allow their children to play there because of poor visibility from homes and the street as well as signs of drug use. The traditional neighborhood also had much larger yards than the mixed-use neighborhood and the co-housing neighborhood and since girls tended to play more in the vicinity of the homes, the traditional neighborhood may have better fitted their needs.

Boys' engagement in *active play* and use of *open space* underlines the importance of good availability of play fields close to the homes. Their attraction to streets was also noteworthy as many

liked to use streets for different kinds of group games, biking and skateboarding. The designing of child-friendly streets such as cul-de-sacs and back-alleys is therefore an important element in neighborhoods. The popularity of streets as favorite places may however be related to the lack of public play areas for games and wheeled activities. Also noteworthy was the popularity of the train tracks on the edge of the traditional neighborhood noted in the activity log and child-led fieldtrips as an exciting place of adventure. Luckily the train only runs once a week and travels very slowly along the neighborhood.

Neighborhood characteristics in terms of various attractive settings seem to influence children's choice of favorite places and are indicators of neighborhood affordances for their physical activities. No evidence was found for gender differences of favorite places although it is likely that the neighborhoods, especially the traditional, offer fewer public settings that attract girls this age.

5.5 Summary of Discussion

The main findings of this study supported an association between neighborhood morphology and school-aged children's physical activities and the activity settings they seek. In general, the frequency and variety of activities and settings was higher in the mixed-use neighborhood, moderate to high in the co-housing community, and lower in the traditional neighborhood. Almost all of the neighborhood activities in the three neighborhoods were lifestyle activities, mostly active play and travel between places. However, there was a noticeable difference in the proportions of types of activities by neighborhood. The results indicate that environmental factors, such as interconnected path systems weaving together important destinations such as formal and informal public outdoor settings and indoor facilities contribute to children's physical activity. The findings also revealed unexpectedly low engagement in nature activities although such nature areas ranked highly as most favorite places. Thus, the number and types of physical activities, settings used, mobility and favorite places appear dependent on neighborhood affordances. The findings correspond well with Gibson's (1979) theory of affordances and Heft's (1988) functional approach to the environment in ways children relate to the environment and intuitively use it for physical activities.

A consistent gender difference was identified throughout the findings; the boys were engaged in a greater number and variety of activities and settings and traveled greater distances which supports results from previous research (J.F. Sallis, 1993; Trost & Pate, 1999; Trost et al., 2002). It is also

possible that boys prefer outdoor activities more than girls as has been suggested by the literature (J.L. Frost et al., 1998). No specific reasons in terms of the physical environment were found to explain gender differences but it can be hypothesized that the neighborhoods do not afford enough opportunities of interest to girls. The prominent gender difference raises questions about gender activity patterns in general and their relationship to neighborhood affordances, especially in term of variety of settings.

5.6 Limitations of the Study

Several limitations can be identified related to the selection of population, case selection, and methodology of this study.

1. Although this study focuses on children's physical activity, the concept of "self-selection" (Bagley & Mokhtarian, 2002; S. Handy & Clifton, 2001) may have affected the results in terms of parents' choice for neighborhood. In this study, people seeking active living may choose to live in mixed-use, walkable neighborhoods, people seeking strong sense of community through shared facilities and closeness to nature may choose to live in co-housing/eco-villages, and people who seek to live more privately may choose to live in less dense, traditional neighborhoods. In fact, recent research suggests that self-selection of respondents may create physical activity differences between neighborhoods. If that is true, correlations between the built environment and physical activity cannot be concluded as cause-effect relationships, but just influential associations (S. Handy, Cao, & Mokhtarian, 2006; Khattak & Rodriguez, 2005). Therefore, this study was not aimed to generalize to a larger population but rather focus on populations residing in particular "types" of neighborhoods. The potential influence of parental self-selection and activity encouragement is still a valid concern.
2. The participants were mostly white Americans with an upper-middle socio-economic status and high educational levels of parents. Therefore, the findings are limited to similar population groups and may not be true for other types of populations.
3. The findings may also be biased by the selectivity of people who choose to participate in research on physical activity that is, people who are more active choose to participate.

4. The children who participated in the study were limited in age from 9 to 11 years of age. Individual differences and previous experience were not taken into consideration in the selection of participants.
5. The location of homes within the neighborhoods and the distance and/or safe access to physical settings may have affected children's permission to engage in physical activities.
6. The location of the three settings was limited to suburban neighborhoods built during the 1990s in the same geographical region (Central North Carolina). Comparisons and/or generalizations require careful consideration of influential local factors which are described in the methodology chapter.
7. Given differences in the size of the neighborhood units, comparisons should take into account differences in participant populations.
8. The data collection was limited to out-of-school physical activities and did not incorporate activities during recess, physical education classes and after-school programs.
9. The data collection was mostly limited to spring and early summer physical activities. Seasonal differences were thus not taken into consideration in the study. The findings may be affected by the change from winter season programs to the beginning of summer programs.
10. It was taken for granted that the school year calendar was approximately the same for the neighboring counties but some of the participating children were taking end of grade exams during the week of study.
11. Differences in the scale of the aerial photographs of neighborhoods may have influenced children's responses in that the scale in two of the neighborhoods was 1:400 feet but 1:800 feet in the third neighborhood (the co-housing), which was an additional research unit. Further, the quality of the aerial photographs may have affected the recording of settings as some of the children were not very accurate when tracing their routes and some thought the scale of the aerial photos was too small to work with.



6 Conclusion

6.1 Neighborhood Design Influences Children's Physical Activities

This study addressed the need for documentation of the frequency and variety of children's physical activities, the diversity of settings they used, the distances they traveled, and their favorite places in the context of neighborhood design. Central findings demonstrated differences in activities as a function of neighborhood morphology. The mixed-use neighborhood, characterized by greater levels of affordances, was associated with a higher number and variety of children's physical activities, greater diversity of settings used, and greater distances traveled. The traditional neighborhood, characterized by lower levels of affordances, was associated with lower levels of child activity, more localized, home-based activities and out-of-neighborhood activities. The co-housing community, characterized by moderate levels of affordances was associated by intermediate levels of child activity.

The fact that nearly all child activities within the neighborhoods were defined as *lifestyle activities* may be an indication that children are not engaged in cardiovascular activities needed for healthy development. An implication is that more attention should be paid to increasing facilities for organized sports such as ball fields and swimming pools, and other types of recreational and plays settings suitable for this age group including activity encouraging school-grounds, circuit training, skate-parks, and adventure playgrounds.

The distribution of formal open spaces such as parks and play areas in the vicinity of homes, and the inclusion of safe pedestrian routes are important. To increase the use of such settings and sense of safety, they need to be visible from streets and homes. Vegetation for shade and plants of interest to children should also be incorporated.

The importance of child-friendly linear settings such as sidewalks and greenways was supported by the findings and underscores the importance of providing play areas along frequently used pedestrian paths. Children in neighborhoods with lower associations between activities and neighborhood affordances were more dependent upon walking and playing in the streets and cul-de-sacs, reflecting their use of settings designed for automobiles. Their habitual range and mobility was

restricted due to the lack of pedestrian paths and unsafe roads. Thus, pedestrian paths and tertiary streets such as cul-de-sacs and alleyways should be designed not only as routes but as specific types of behavior settings. In fact, paths— are often the liveliest places in the neighborhood, places where sense of community grows, places where people are coming and going, places heavily used by children, and places where the community keeps an indirect eye on things. Large streets and/or streets with heavy traffic are an obstacle to children's mobility. In cases where streets disconnect places that are important children, provision for safe crossing have to made.

The size of the built environment may also play an important role in terms of mobility and home-range. The findings showed that the extent to which the child could walk to the school and settings for play and recreation is an important indicator for physical activity. Suburban neighborhoods should be large enough or connected well enough to support an elementary school within a walkable and safe distance from the homes of the youngest children. Providing safe and walkable pedestrian routes to school is crucial in the promotion of children's active lifestyles. In fact, there seems to be a relationship between school's walkability and children's increased mobility and home-range.

Although available literature emphasizes the importance of exploration and nature activities, and children ranked such nature settings high as favorite places in this study, the findings demonstrated that such settings were rarely used. In fact, the children rarely crossed the boundaries of the built environment. On the basis of field-work notes, children's choice of favorite places is not only linked to the quality of the physical environment, but is also probably affected by social contributors, such as parental safety concerns. Children's attraction to natural areas, especially those with water features, requires more attention in future research. In order to provide children with more opportunities for free play and exploration in natural settings, it is important to include the design of nature corridors within the built environment and to pay more attention to safety issues such as visibility from streets and homes and safe access. Natural areas with creeks, ponds or lakes need to be conserved and a safe access provided. Man made settings with water such as overflow ponds should be designed for multiple purposes including children's play.

The finding of gender differences in children's activities calls for more attention in terms of physical activity opportunities and choice of place by gender. More consideration should be given to places of interest for girls and their needs in the design of play areas and equipment. Boys' engagement in active play and use of open space, streets and paths, underlines the importance of good availability of playing fields close to the homes and child-friendly streets such as cul-de-sacs and back-alleys.

6.2 Methodology

Using a combined qualitative-quantitative research approach requires familiarity with both qualitative and quantitative research paradigms which have evolved within different academic fields. Although this approach seemed desirable it proved to be very complicated both in terms of research design and structural format since each approach involves different methods of data collection and analysis and different styles of writing and communicating results. The use of different methods for data collection, does however give the researcher a better and more holistic, cross referenced view of the relationships being studied.

The most important aspect of using a combined quantitative-qualitative methodology was first and foremost the fact that the fieldtrips brought in a whole new perspective of in-depth, first hand information that explained many of the findings obtained with the other two methods. It also addressed methodological limitations; the parental questionnaire provided parental perception of children's behavior patterns and the activity log was limited to a short period of time, excluding behavior patterns that did not come though during the data collection period.

The step-by-step multi-method approach used in this study proved to be an important tool when studying children in context and gaining parents' trust in several ways. First, the standardized parental questionnaire served as an introduction to the study for the families. A second feature was that the children's activity log kept the researcher at a distance but provided a personal link between the participants and the researcher when the log was picked up from the child. A heightened sense of involvement likely resulted in more participation in the child-led fieldtrips and the fact that most of the parents' allowed their child to go alone or accompanied by a friend with the researcher.

The children's activity log proved to be a viable method for data collection for children this age and the child-led fieldtrips provided important in-depth information that would be difficult to collect otherwise. The information gained with this approach underscores the importance of first hand data collection and can be enhanced in future research with more advanced methods, such as internet surveys, accelerometers, motion sensors, and GPS tracking connected to GIS mapping (Mackett et al., 2007).

6.3 Future Research

Thirty years have passed since the major research studies in this area were published; that of Colin Ward's *Child in the City* (1978), Roger Hart's *Children's Experience of Place* (1979), Berg and Medrich *Children in Four Neighborhoods* (1980), and Robin Moore's *Childhoods Domain* (1986). Subsequent research expanding on the lessons learned remains very limited and only recently has research focused on establishing the connection between public health and community design. Very little is known about environmental determinants that affect children's physical activity in residential settings. More research is needed in order to further examine the impact of the physical environment on the types and levels of outdoor, out-of-school, physical activities of children. Although research demonstrates increasing inactivity and decreasing physical activity, the findings from this study in terms of types of activities children engage in, settings they seek, and physical obstacles were in consonance with those thirty years ago.

This study was theoretically driven using three theories in the field of environment and behavior: Barker's Behavior Settings Theory, Gibson's Theory of Affordances, and Bronfenbrenner's Ecological Systems. These as well as Heft's functional approach of identifying physical properties supportive of children's activities provided a useful framework in the classification of types of physical activities and physical settings developed in this study. The classifications of types is a contribution to the further development of functional frameworks for future research and neighborhood design that better supports children's outdoor physical activities. More attention needs to be directed towards identifying children's developmental needs and the definition of appropriate physical activity determinants. The focus needs to be on "systems of affordances" that is, the developmentally appropriate and appealing destinations and a multitude of the linear settings that connect them.

6.4 Proactive Solutions

Proactive solutions for quality environments are still very thin on the ground, and rarely focus on the environment as an interactive system of organized sets. The results of this study may provide a reference framework for designers, planners, policy makers, politicians, public health officials, educators, and developers, for policy making, city planning, and the design for health-promoting neighborhoods. A step-by-step consultation of principles can lead to a model for the establishment of

a fully synthesized community. The application of existing empirical data can be used to further develop blueprint strategies in order to define children's needs and neighborhood affordances that provide the stage for physical activities.

The preventive value of good neighborhood design for children's well-being is clear. Experientially rich and diverse environments promote children's physiological well-being; they are also essential to their social and psychological development. Future neighborhoods should be designed to provide the physical, interpersonal, and socio-cultural environments that support optimal development of children and with sensitivity to individual differences and capabilities.

Plan for needs-design for use!

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8 Appendices

8.1 Appendix I: Fieldtrip Narratives

The activity log was followed-up with a child-led fieldtrip including an open ended interview to explore other possible contextual influences that could not be detected from the other two methods. The goal was to get a more holistic picture of children's perceptions of their environment, their favorite places and home-range and thus, provide a deeper understanding of the relationships between places, affordances, and activities. Seventeen children were selected from the three neighborhoods, nine girls and eight boys, eight from the mixed-use neighborhood, six from the "traditional" neighborhood, and three from the co-housing neighborhood.

8.1.1 Fieldtrips in the "Mixed-use" Neighborhood

Six child-led fieldtrips were done in the mixed-use neighborhood with eight children, four girls and four boys.

1. Ten years old girl "A"

June 2002 13:30, 1 hour

I had briefly talked to the girl's father when I picked up the activity log. We had a very nice talk about his daughter and other children in the neighborhood. He described how his daughter likes to go places in the neighborhood and how well she knows the neighborhood. "She doesn't want to go with us (her parents). She likes to be with her friends or alone" he told me. With this information in hand, I thought A would make an excellent neighborhood expert candidate.

As I got to A's home as scheduled, she and her parents had forgotten about the fieldtrip. She had gone with her father to work. The girl's mother was at home and called A's father. Two hours later, I met A. We sat down in the backyard and briefly reviewed the log. Behind the house are woods and she told me how she likes to go there and explore the wilderness. Sometimes she goes all the way across the woods to another neighborhood. Her parents did not want to join us on the fieldtrip. The first place A wanted to show me was a place near the elementary school. We took my car to the school. She wanted to show me the woods behind the school. When we were walking to the woods, she told me how she loves the woods and really cares about animals. We talked about the ecosystem recycling and how much people waste. She seemed very concerned about waste. She also talked about cruelty to animals and how some kids trap and try to catch frogs and other animals and are not careful hurting them. "I don't like kids who do that," she said.

We followed a path in the woods. This day the tree canopy was exceptionally beautiful (Polonia)! The creek in the woods was dry after months of drought. Suddenly, we came across a little puddle with about thirty minnows (little fish). We decided to cancel the rest of the fieldtrip and run (drive) back to her house to get a bucket and net and save the fish by moving them to the nearby pond. I drove A back to the school and she was going to transport the fish to the pond. We scheduled to meet next week. Unfortunately, the follow up fieldtrip did not happen because of a misunderstanding.

2. Nine years old boy “J” and eleven years old “I”

June 2002, 11:30, 1 hour

J and I are brothers. I met with them and their mother at their house. We reviewed the activity logs and filled in missing information. The brothers are good friends and usually play together, their mother told me. Therefore, it was decided to go on a fieldtrip with both of them.

The first place they wanted to show me was the alleyway behind their house. They use this alleyway, sidewalks and the greenway when they walk to and from school (which is about ¼ of a mile away). They say it takes about 30 minutes to get home from school but much less time in the morning. They use the back alley a lot – it is their playground. There, they play ball (tennis ball) all the time. They showed me a branch they use as a goal and how they throw the ball.

On the other side of the alley is a pond. They tell me that they play a lot around the pond. “There is a “fun island” in the pond and we have a lot of fun there.” The island is covered with water lilies and there are two really wet dirt paths connecting to it. “The water level is very low now,” they said. “In the winter it is much higher and then we cannot get over to the island”.

In the pond is also what they refer to as the “concrete thing”, which turns out to be a water overflow pipe. They climb on to the pipe (about 30’ long) and use the concrete as a stage for many pretend plays with friends. “Lord of the Rings” is an active game they play a lot and includes fights (battles) with swords (twigs). Sounds like a lot of fun! They also told me how once, one of their friends accidentally detached the pipe and “drained” the pond and that their neighbor (who maintains the pond) told them not to play there. They told me they still play there, but are more cautious now.

We walked around the pond. They threw twigs and stones in the water. The bank on the other side is very steep. That is also a setting for pretend play. The slope is a “side of a mountain” and there is another island. They stopped and threw stones at the island and told me about the many hideout spots around the pond.

Next, they decided to show me “the tunnel”, a place they refer to as another favorite place. “It is really overgrown now,” they said. As we reach “the tunnel” I saw that it is an actual water tunnel under one of the main streets in the neighborhood. They told me that they go there quite often and that they even used it in their birthday party as a place to hide a clue in a Lord of the Rings game – a place where the black riders are. They told me that their mother does feel o.k. about them playing there. They showed me around and it is indeed an exciting place and easy to imagine all kinds of adventures taking place! “In winter,” they told me, “there are ice-sickles in the tunnel.” From the tunnel, we climbed up on to the bridge. There, they told me is a good place for snowball fights. They also use the bridge/tunnel in hiding games. It is their “secret spot” and not many kids go there. It is also a place to collect twigs.

3. Eleven years old girl “S”

July 2002, 10:00., 2 hours

I met with S and her mother at their house. S was very excited about showing me all her favorite places. First we went to her backyard. There is a big lawn that slopes down to the woods. S likes playing with her dog on the lawn. They play soccer. There, she also plays croquet, badminton and tetherball (pole).

We walked down to the woods. S wanted to show me her tree house. I had to take my shoes off and wade in the creek to get to the tree house. There was a large fallen tree and S. had placed a ladder in the creek to climb up to the tree house. She was very careful not to damage the many spider webs found there. She really likes spiders and spider webs. The tree house is her private hideout. She spends a lot of time there. “I wish you were 10” she said, “because my friend’s moms don’t allow them to come here. They are afraid of ticks and snakes.”

We walked around an “island” in the creek (a bend) and got to another hideout – the raft. S described how beautiful this place is in the spring; “Then the banks are covered with beautiful moss and it looks like a meadow under water and when it rains there are little waterfalls.” Later she added; “There are also fish minnows. Once I found a dead silvery fish. It had died because the water was too shallow and that made me feel bad.” She described how she then decided to dig deep holes in the creek and also create islands of mud. The bushes in the woods are loaded with blackberries. Her mom picked them and we ate a handful. Once, S found deer bones in the woods, which made her very excited. Her older brother also has forts in the woods. “He doesn’t use them so much anymore” she told me. There are probably four or five forts there. Next, S showed me a bridge and pointed out how it works like a trampoline. She likes to roll in the mud. S told me how the kids don’t like to use other kids’ forts and that they like to build their own. A tree fell on her tree fort so now she’s moving everything to the other tree house. On our walk through the woods, she told me how a deer once startled her and her friend, something they were obviously very excited about.

We left the woods and walked across the ball fields. S likes to play with her dog in the sand in the volleyball area. “Kids don’t use the fields so much for ball play” she said and added to further explain, “The grass is badly maintained, but a lot of people take their dogs here.” From the ball fields, we walk over to the community swimming pool. S said she goes there a lot. “I’m here usually in the afternoon but most kids come here in the afternoon,” she explained. Her mom has a bell she rings to call S in. The other day, she told me, she was at the pool and didn’t hear the bell and it was almost eight o’clock when she came home. From the pool we walked over to the pond and watched her dog swim and fetch balls S would throw into it. S also told me that she did a school project on erosion. She loved working on the project and now really understands the importance of erosion control. She showed me “the branch” in the stream by the bridge – she used to go there and play with her dog. S is allowed to go anywhere in the neighborhood but needs to tell her mother where she’s going which she always does.

On the bridge (obviously a place where she likes to stop and look around) she found a dead bumblebee – she’s very sensitive to animals and nature – “I wish there were beavers here,” she said. We walked up the hill to “The Far Away Park” near the café. S likes to walk barefoot in the sand and play ‘selling things’ in the play structure. When asked how the play area could be improved she replied “more flowers- because it looks and feels so dry here. It would also be nice to have a ditch and maybe sprinklers.” Then she added “the swingset is too small” and showed me how she barely fit in the swing.

We walked up to the café on the corner. S gets \$ 2 a week in allowance – chores: vacuum & take her dog out on walks. She sometimes comes to the café to buy ice cream. Then we walked to the old graveyard across the street. S comes to the graveyard a lot. She likes to read the tombstones. One fell on her friend’s foot. She comes here about once a week. Once, she discovered a path to a big rock. Every time she comes here she ties her dog to a stump and walks to a big boulder (overhang). She stands on the rock and enjoys the view of the neighborhood. Standing there makes her feel like she’s flying. She feels like this is kind of her own private spot. We walked to the graveyard exit and there S sat down on the stairs wall. There is a nice fig tree with figs in large clusters. S and her mother talked about the history of the place and how neat it is to have the graveyard.

S (and her mother) likes to collect things. Once, S. found an old coke bottle in the streambed. It dated from 1918. S loves to find things and look for adventures. From the graveyard, we head to the woods by the school - to the “Moon shiners Cabin”. “It’s a place where...of course...” S said. There she finds all kinds of things; bottles, copper, tubing, bedsprings – an exciting place soon to be cleared and made into a country park!

4. Ten year old girl “B”

July 2002, 13:00., 2 hours

I met with B at her home. First, we looked through her activity log and I asked her and her mother questions about the log. B’s mother joined us on the fieldtrip. B said she finds it interesting to walk home from school. On her way home from school she is accompanied by her two brothers, age six and seven, and their seventeen-year-old babysitter.

Our first stop was at a little playground located next to the greenway she uses when she walks to and from school /as many children do – observations). She likes to stop here and use the swing set on her way home although as she said “there might be more”. On the other side of the playground runs a creek. When asked about the creek it seemed like she didn’t want to talk about it, but when probed she told me that they go down to the creek almost every day. She probably felt uncomfortable talking about it with her mother listening – not being sure whether she is allowed to go there. B knows many paths down to the creek and she told me that not many kids go there on the way home. In one of the creek’s paths is a small waterfall (today there isn’t much water in the creek) and a fallen tree across it. “Usually we walk through three tunnels, she said and continued “We’ve got to be careful there because we’ve seen a copperhead snake (on hot days). We walked a little closer to the creek and she told me that now the vegetation is really overgrown. As we climb down to the creek she said, “we have particle boards to jump on and there are honey suckle and strawberry plants. She continued and explained that her brother likes the honeysuckle more than she does. The entry way (actually more like a vegetation gate) to the creek is a need enclosure with a log to climb over down there. “My brother gets poison ivy”, she explained to me and I understood her so that I needed to be careful too. Now by the creek there are black berry bushes (“prickle bushes” she calls them). We headed back to the greenway. The bank is steep and hard to climb. She showed me how I needed to hold on to roots and pull my self up. B lent me a hand.

Our next destination is the pond. B likes to throw sticks and stones into the pond. She told me that once her brother dropped their dad’s 20 year old basketball in the water and it took them about 20 min to get it back using brands and stones. She paused and then told me that there are lots of frogs and toads in the pond. “There are also dragonflies and water lilies,” she said. “Now the water board is really low” she explained and then added “usually we cannot get easily to the island (which is a concrete overflow close to the center of the pond). “We like to climb on the concrete and throw stones.” “There are snakes around the concrete - friendly snakes,” she added.

We continued our exploration around the neighborhood and approached her home. B’s house is by a cul-de-sac. She told me that they sometimes play in the cul-de-sac, games like tag and baseball. She also told me that she doesn’t like the boys down there.” “Sometimes we have wars – we get into a fight with them.” “I would like to punch them in the face,” she added. I asked her if they any other games in the cul-de-sac, which has an unusually large grass circle in the middle. She told me that they don’t hide/go seek because there are not enough hiding places – except on the street-hiding behind curb/cars.

We walked back to her house and she walked to the backyard. B. told me that she likes the play equipment because it has all sorts of jumps and swings, and bars for hanging. “We also leave junk in the backyard and there (she pointed to the wooded area) my brothers built a fort”. “Now, they are moving it”. “They left a backpack high in the treetop with all kinds of things”. “I don’t like how they break the branches and hurt the tree.” “We also have squirrels and birds (robins) in the shed.” and, she added, “Sometimes we find lizards and jumping spiders inside the shed.”

5. Nine years old “K” & 11 years old “M”

June 2002, 11:00., 1 hour

“The adventures of M & K” (and sister E who has already graduated from high school) is the title of their fieldtrip chapter, they decided as we took off from their house.

K and M live on the only cul-de-sac in the mixed-use neighborhood. When I got there they were not home but their mom expected them back shortly (20 min.). I had met with their mom (a nurse) several times before and she had told me a lot about the mixed-use neighborhood and the life around the cul-de-sac. I walked with her down to the creek, a favorite place of their three kids especially their youngest (6 years old daughter) who is a partner in “The Adventure girls of crazy creek,” she explained. We walked along the sewer row (moved twice a year) and took a path that leads to the middle school. We got back to the house and she had to leave (by bike) to pick her daughter up from camp.

I waited a few minutes until the boys came home. It took a while for them to understand what we were going to do and why. They quickly decided that there were so many places they had to show me and therefore we would need to ride the scooters. O.K. there’s always a first time for everything, I thought, and this would be my first scooter trip. They put a helmet on my head and off we went. On our way we met E, their older sister, and she wanted to join us. Luckily (for me) she offered me her bike and her helmet and then ran home to get another bike for herself. So after that I and E were the bike riders. We rode down the alleyway to Parkway Crescent. Our first stop was at the bridge. They explained how they like to explore the bridge and creek area but they are afraid of snakes. Earlier (on their way home from camp) they had seen a snake and were “scared”. They said it was a big black snake and I told them that it was probably a friendly black garden snake. I asked them about the texture and shape of the head and then they made fun of themselves for having been “scared off by a friendly snake – how dumb of them, they thought!!! In winter they like to go down to the creek and walk under the bridge.

Close to the bridge and right next to the greenway there is a small playground. They told me they like the play equipment. When asked how/if it could be improved they responded promptly that they think there could be more equipment.

We went to Quinn’s café and they proudly showed me around. We ordered bagels and drinks. The brothers were enthusiastic about showing me all the “treasures” the neighborhood has to offer. They really like to “go places” but usually don’t stop so much – it’s more the act of going places.

We walked the bikes across the street to the cemetery (they referred to it as “the cemetery” but on another fieldtrip it was referred to as “the graveyard” or “the old graveyard!”). They told me how they like to read the engravings and think about the people. We continued up to the movie theater. They love going to the movies and are so lucky that their sister works there. They get to see so many movies - Star wars 8 times! They also like the game machines.

From the movie theater we walked to the grocery store. “There isn’t much you can buy here,” they said “and the chocolate is really strange (health food!)” “Soon, there’s going to be an ice-cream store here!” They are really excited about that. From the grocery store we rode downhill to the school. We walked around the school grounds. M likes the play equipment there. He is doing summer school because he didn’t do well in reading. He wants to be a doctor when he grows up. K explains that he is more the sport type. He loves baseball and soccer and wants to be baseball player. He likes the basketball area. They also showed me the garden. It’s kept locked so that no one can trash it, they explained. They both seemed somewhat excited about the garden – it is obviously one of the “treasures”. As we were leaving the school grounds, we walked along the edge of a wooded area and they mentioned how nice it is there, but they didn’t want to show the woods to me, probably because it was getting really hot. We rode the greenway back. They quickly showed me the swimming pool and then we rode the street and alleyway back to their house. They told me how they like riding all over – and they do go all over the neighborhood. They are really good friends and do everything

together. They stooped at the pond and told me they like to stop there. They also like the cul-de-sac and they can play many games there.

6. Ten years old girl “T”

June 2002, 10:00., 1 hour

I got to T’s home around 10 a.m. They had forgotten that I was coming. I waited for about 20 minutes for T and her mother to get ready. We drove in my car to the swimming pool, a favorite of T’s. She goes to the pool quite often in the summer and usually walks or rides her bike. She spends most of the time in the water 1-2 hr. at a time with about 10 minutes break every hour.

Next we stopped at the bridge next to the pool. T likes the bridge and she likes to go down to the creek. Sometimes she walks along the creek “to seek adventures” and “imagine things”. She doesn’t touch the water in the creek. I asked her why and she replied in amazement “the water is dirty, it has poop!” She also told me that now it’s overgrown and that they don’t go down there.

T told me that her mother wants her to come home immediately after school- “no stops on the way” she said. She travels to and from school with her six years old brother who rides his bike slowly because it is small and not good! But as I continued to ask T about her activities it became clear to her mother that they make frequent short stops on their way home from school. “Sometimes it took them about ½ hr.” her mother said, “and I start to worry.”

T moved freely and obviously enjoys being outdoors. She notices every little detail in the environment and looks for flowers, leaves, and small animals. Her eyes shimmered when talking about what she finds. It seemed like T’s experience and feeling for the environment came as a surprise to her mother.

Next we drove to a little neighborhood park. T really likes to swing and she also likes to climb on the monkey bars. “The slide isn’t good” she said, “It is too short and too steep in the center.” She showed me how. She thinks the playground might be improved – more like an “amusement park”. T picked up a branch and she and her mom (we were walking the greenway towards the school) told me how they love to walk there in the fall and try to catch falling leaves. T now noticed many things and adventure possibilities. She told me that she usually doesn’t talk to kids (at the playground) she doesn’t know. She sticks to the ones she knows, she said. She looks out for her brother too. When asked about the playground and other kids she said that kids usually only stop there when the weather is good – not too hot and not too cold. “They also stop to pick flowers on the slope down to the creek, which she refers to as “tunnel number 1” and they like to stop to get “honey suckers.”

On her way from school they’d rather bike on the grass next to the “school pond” than ride down the paved path. The slope there is more fun (there are signs of many kids doing that – in between a couple of bushes).

T really likes the school and her teachers. Now, suddenly, as we spoke, there were zillion frogs jumping all over. They probably just hatched because of the rain yesterday (It hadn’t rained in a long time). T was very careful not to step on any of them.

Next we drove to another neighborhood park. T had wanted to show me the movie theater but we decided to skip it because there was not much time left. The park is kind of the entrance of the path to the middle school (her older brother goes there). T told me that she and her friends (who she has many) and her little brother go there sometimes. The path is very nice and runs uphill through the woods. We came to a bridge and T told me and acted out how they break “coconuts” on the bridge. They find rocks to break. I asked her why coconuts and she said they’re really not actual coconuts but acorns from the big oak tree. The acorns fall on the bridge.

“The creek is hasty,” she said, “and it needs to be cleaned.” “People throw stuff here too.” She also told me a story of some older kids who claimed the woods. “They had a fort here and we

were afraid of them.” She referred to them as “bad kids”. She continued and told me that once they had to run off the path and into the woods to flee from them. Now she doesn’t see them anymore and the fort is gone too. We followed the path to the middle school and T told me that they don’t go there because there is nothing there to do (There is nothing there, just moved lawns, unattractive chain link fences). We walked back to the park. T likes the park and told me how she and her friends play witch & haunted house in the play equipment and rollercoaster in the swings. She doesn’t do the rollercoaster anymore – it makes her dizzy and sick.

7. Notes from conversations with the children and their parent(s) during log reviews

- a) Mother: “There are lots of intergenerational activities because of the high-density living. For example, someone is usually out, playing ball, walking their dog – and this leads to involvement/activities. Most of us experience many non-organized activities such as singing together, spontaneous sports, spur of the moment dinners etc. – all without getting in our car. We only have one car (for the first time in 25 years!) even though we both work outside the home”. Son: “Me and my friends play lacrosse in the street and in the fields”.
- b) Mother: “The cul-de-sac is a meeting place for children throughout the neighborhood (*researcher’s insertion*: there is a large grassy field in the center). There, we’ve had field days, art in the park, carnival, moon bounce, bingo, lemonade stands, sold candy, made posters, bike races, and Easter egg hunting. We also roller blade, skateboard, play games such as 4 square, croquet, bubbles, and sidewalk chalk, x-mas decorations and scavenger hunt.”
- c) Mother: “Participating in this study makes me feel more confident about my son’s whereabouts- both ‘routine places’ and favorite places. Unfortunately it was so hot – he usually would spend more time outside” “Many families use walkie-talkies. They now design pants with pockets for walkie talkies!
- d) Father: “Teams use the school grounds not the ball fields by the pool because of dog poop!” “She is more active in the summer than winter because of the swimming pool.” “She likes most of the areas and she loves to swim and jump rope. She also likes to roller blade but the neighborhood is too hilly.” “The neighborhood needs more shaded areas with wood chips for picnics and the play equipment is only for smaller kids. The greenway needs to be longer, more continuous and connect to places outside the neighborhood.”
- e) Mother: “My daughter is working on a major school project with spray paint and need to do that outside in the back yard. She likes the trails behind the school and the graveyard park where there are hunted walks on Halloween.”
- f) Mother: “My children are not allowed to walk to school without supervision because they need to cross streets (*researcher’s insertion*: live within ¼ of a mile from the school).”
- g) Mother: “This is kind of an unusual week because she has dance rehearsals and EOG tests. She would usually spend more time outside.”
- h) Mother: “He likes climbing and jumping on the big rocks on the way to school and in the graveyard. There used to be a construction site with big rocks that he liked a lot. Now it’s built. He also likes building forts in the woods.”
- i) Father: “We drove to school all days except one or two (*researcher insertion*: they live within ¼ mile from school). On those days she usually rides her bike to school.” “She doesn’t want to walk with adults. She wants to walk with her friends at their speed.”

- j) Mother: “He liked using the neighborhood map and the pens.” “He really liked participating in this research.”
- k) Mother: “She learned to use a map and think about the places she goes to. It was surprising to me how many places she really goes to in one day.” “It would be good to underline that parents can help.” “People are suspicious about child research identifying places where kids go especially due to a recent kidnapping attempt. It would have been better if there had been a letter sent from the school or the neighborhood association.”
- l) Mother: “It was good to see where she goes.” “She always walks to and from school.”
- m) Mother: “It was hard to find time for this research. I really like the idea of this research especially the maps.” “Today kids are less independent and need parents’ assistance when recalling.”
- n) Father: “We liked the caricature and the maps. They could have been more 3D and have more cartoons.”

Summary from Fieldtrips in the Mixed-use Neighborhood

Eight children from the mixed-use neighborhood participated (four girls and four boys). They all described a rich environment with many places of interest. They appear relatively free to roam around and like going places in the neighborhood. They use the opportunity when walking to and from school to play and explore places on the way, both planned places such as playgrounds and natural places such as woods and creeks. The girls seem to be more drawn to private settings such as back yards than the boys. Both boys and girls mentioned a variety of formal places such as the school grounds (ball fields), parks and playgrounds and the community swimming pool. The gender distribution of formal settings was similar although the boys seem to like streets settings more than the girls. Informal settings were also very popular especially the woods. They go there to seek adventures and are drawn to creeks and the wildlife in the woods. Some also mentioned forts and tree houses in the woods as places of attraction. The girls play around smaller settings such as forts and are looking for things, whereas the boys prefer larger areas such as around the pond and the tunnel/creek for adventure games.

Table 3: Summary from fieldtrips in the mixed-use neighborhood

Extracts from fieldtrips in the mixed-use neighborhood									
Settings / participants	girl (10)	girl (11)	girl -10)	girl (10)	boy (9)	boy (11)	boy (9)	boy (11)	Σ
Private settings									
Backyard		x		x					2
Formal settings									
Park		x	x						2
Playground		x		x			x	x	4

Table 3 (continued)

School grounds			x	x			x	x	4
Ball fields		x							1
Swimming pool		x	x				x	x	4
Alleyway					x	x			2
Cul-de-sac				x			x	x	3
Paved path (e.g. to school)			x	x	x	x	x	x	6
Around the neighborhood	x	x	x				x	x	5
Bridge		x	x		x	x	x	x	6
<i>Informal settings</i>									
Woods (e.g. forts)	x	x	x	x			x	x	6
Old cemetery (in woods)				x			x	x	3
Pond		x		x	x	x	x	x	6
Stream/creek		x	x				x	x	4
Big rock / overhang		x							1
Informal path (dirt)	x	x	x	x	x	x			6
Tunnel			x		x	x			3
<i>Indoor facilities</i>									
Café		x					x	x	3
Movie theater			x	x			x	x	4
Grocery store				x			x	x	3
Σ	3	13	11	11	6	6	14	14	

8.1.2 Fieldtrips in the “Traditional” Neighborhood

Four fieldtrips were done in the traditional neighborhood. Six children participated and one visiting child.

1. Eleven year old boy “A” and his nine years old sister “G”

July 2002, 15:00, 1 hour

I met A and G at their house. Their mother came along with us on the fieldtrip. She told me that the kids usually hang out a lot in their back yard and their friends’ yards. A wanted to go to the cul-de-sac across the street to show me where the boys play games. There was a basketball rink there and he told me that the cars are usually parked in the driveways so they can also kick balls. A has two good friends in the neighborhood and they ride their bikes around the neighborhood and ride on the dirt paths in the woods. From the cul-de-sac, we cut across between houses to the main street and then onwards to a path leading to the woods. A was not very enthusiastic to talk more about what he and his friends do but his sister was much more interested in showing me around. G likes the woods but doesn’t go there without her parents. She likes to walk the paths in the woods to the greenway. When we reached a creek, A decided to turn back home to play a game on the computer. We turned around and walked back to the neighborhood. G and her mother like to talk about the neighborhood and how much they like living there. She likes to ride her bike around but she said she needs to look out for cars. As we walked on the sidewalk uphill towards their house, G pointed up the hill, looked at me, smiled and said “this is the snow hill where we ride sleds when it snows.” Obviously, that’s a lot of fun. Her mother explained that when it snows they set up a road block to slow down the traffic. When

asked about the road that dissects the neighborhood, she said that her children are not allowed to cross the street unless they are with an adult.

2. Eleven year old boy “D”

July 2002, 17:00, 1 hour

D was excited about showing me his favorite places. He can pretty much go anywhere as long as he lets his mother (or sisters) know where he’s going. He frequently rides his bike all the way to the middle school, which is about two miles away. First, they ride a dirt path and then a paved path, he explained. D told me that he and his friend J are always trying to break the record of how fast they can get there and back. The record now is 32 minutes!

Our tour started at his house. We walked between a couple of houses (he told me that the people don’t mind – interestingly his friend A had told me that he would not do that and other kids too!) to a path. I asked him why he goes this way but not directly across the train tracks to the trail. D didn’t think this question mattered and answered that he just does (I guess it probably has something to do with timing and shortest distance). While we were walking on the path, I asked him if there is anything in the woods that he looks for. He said he likes to look for rocks. He used to collect them. He also likes animals. He told me of a three legged deer with cubs (fawn) that comes to his backyard. D told me that he used to carry a bow and arrows with him. He would hunt with it – “please, don’t tell my mom that I shoot animals, he said.” Later during the tour I asked him if he would recognize a copperhead if he saw one and he told me that once he had seen one and that it was hissing at him only a few feet away. He told me that he killed it by shooting it with the bow & arrow (I have no reason not to believe this story).

We crossed the train tracks and got to the creek. “If you take a right you’ll get to the school and left takes you to the railroad bridge”, he explained. It was up to him what he wanted to show me. First, we checked out a place where large trees reach out over the creek. In them were two rope swings (now malfunctioning). D told me that the teens (and him) used to swing and jump into the creek when the water is high.

We kept going, now to look at the bike ramps. We passed his favorite tree, “a loblolly pine that has cancer” he explained. It was a really nice walk through the woods. D told me that there he sometimes finds really neat leaves. He also mentioned that in some places there are beautiful flowers “daffodils.” The bike ramps are actually a whole system of paths and ramps, created by teens. D described how they had someone bring in a bobcat and had drainage pipes pulled in. Then they moved dirt on top of the pipes. This must be such a fun place, I thought.

We walked back to his house through his backyard (he doesn’t play in his yard any more) and back to the railroad tracks. We crossed the tracks and walked through neighbor’s yard. He showed me a place where he and his friend J found a bike high up in a tree and how they climbed up and got it down.

We walked back to the path intersection and this time crossed the stream on large rocks. There were many people on the trail; mountain bikers, walkers and joggers. He showed me a large rock in the creek. We jumped over on to it to look at the fish in the creek. He told me about this big red fish that used to be there. This was a very beautiful spot. Just above the “red fish rock” was a large rock overhang. D pointed at it and told me that this place is his fort where he and his friends sit down and eat their snacks. Now we reached the railroad bridge. D seemed really excited about this place. He likes to look at the graffiti on the bridge supports. He said there is a lot of litter there – beer cans. This is where teens hang out and have campfires.

D has never been further this way. He said the trail pretty much ends there (not quite so). We walked up the slope and on to the bridge. He loved to show me how good he is walking on the bridge. He isn’t afraid. I asked him what he would do if a train came. He said you could either run or step on

the support poles (seemed insane to me!) He has also been here in snow “but then you have to be careful not to slip” he explained. As we reached the end of the bridge he turned around, pointed at a sign and with a big grin said “NO trespassing – Oops- never seen that before”!

We walked the tracks back to his house. We talked about the old play equipment there and he showed me a “small junk collection” there. Upon our return I sat down with his mother who told me that his sisters (now 18 and 22 years old) used to baby-sit him a lot and that especially one of them has had very much influence on him as far as exploring places and stimulating interest for the natural environment.

3. Ten years old girl “L” and her friend “C”

July 2002, 13:30, 1 hour

When I visited L to review the log, she told me that she never does anything outdoors. This lighted up my curiosity. How can one be outside for hours and not do anything? I also found it interesting when she described how she doesn’t feel safe in the park because she cannot see the street. I was determined to find out more about L’s secrets.

I met L at her home. Her mother told me that L is a shy girl. I approached her carefully and sensed that she didn’t feel comfortable talking to me. I asked her if she felt comfortable showing me around her favorite places in the neighborhood and she said it would be all right. We walked slowly on the sidewalk.

First L wanted to show me where her friends live. We made a stop at her friend’s backyard. She said that they hang out there, sit or swing and watch their dogs play. She said they never play there, and really don’t do anything but watch the dogs and swing. She never goes inside her friend’s house. Most of the time they go over to another friend’s house to play computer games.

I thought that perhaps L would tell me more if her friend C would come along. I had not met C before. She is a participant in the study, but my research assistant had talked to her. I spoke with C’s father who encouraged her to join us. Together L and C decided to show me the woods behind C’s house. C has only lived here for a year. In her backyard there were many bird feeders and bird houses. I asked C if she’s interested in birds and she replied “no not really.” The bird feeders were here from previous owners. There is no grass in the backyard. C said she wished there was grass because it isn’t good to walk barefoot on the ground (pine needles and cones). L suggested they would show me “the hill”. We climbed over a fence and into the woods.

Neither girl likes to talk much, but I kept asking them about what kids do in this neighborhood and what they like to do. They showed very little interest in the surrounding environment. We approached the hill (slopes of fill for the airport). I asked (a few times) what they do here and why they come. They were silent but had a little grin on their faces. Finally, they told me that they come here to do yoga and meditation! The hill has become their own little secret place. I asked them to show me where they usually sit down and asked if I could watch them do yoga. They were very shy but agreed to do so. Facing the woods with the airport in the back they sat down. Meanwhile, I sat down and took notes. Afterwards I was curious to know what they were thinking of while they were doing the yoga exercises and they both said they thought of the beach. L had invited her friend C to come to the beach with her family for a weekend and they both seemed excited about that.

We went back to C’s house. I asked if they could show me the park (playground in the woods). L had told me she doesn’t like. They agreed to do so. When we approached the park L’s mom picked her up. I walked through the park with C who told me that she was not allowed to go there without an adult. She told me that once she and L had found beer cans and trash there and that after September 11th their parents did not want them to go there anymore. Coming back we crossed a bridge and C told me how they used to let matchboxes float downstream – how they would run up

and down to watch the float. The park is next to the street that cut the neighborhood into two parts. I asked her if she is allowed to cross the street and she said she is not unless she's with an adult or someone older. "I don't have anything to do there, because all my friends live on this side," she added. We walked back to her house. I asked her (as I had asked L previously) if they ever played neighborhood group games with other kids in the neighborhood -any street games, ball games etc. L had told me no, but C said that in her cul-de-sac (which they refer to as C's court) they often play games such as soccer and tennis and that sometimes there are as many as 10-15 kids there.

4. Ten years old girl "J" (and her cousin "M")

July 2002, 18:30, 1 hour

I met with J at her house. I talked to her aunt and her father before we took off. J is a really outgoing girl. Earlier she had told me about many interesting places in the neighborhood and how children make use of spaces otherwise not designed with children in mind. Her cousin M was visiting and J asked if he could come along. J was excited about taking her cousin along because she really wanted to show him around too.

Our first stop was at her street to check out some daylilies at a neighbor's yard. It was M who was attracted to the daylilies - or rather the dried flower sticks. J said it was ok to stop there but emphasized that these were just dead flowers. To M they were obviously something else and more. I pulled out a few sticks and challenged them in a "sword" fight.

The first thing J wanted to show me was her favorite tree, a large silk tree across the street. She picked a few flowers to take home with her. Next, she took us to a friend's house to show us the garden there. J explains how she loves the flowers there "it is so beautiful here," she said with a deep expression. One of the neighborhoods cul-de-sac's is J's favorite place of all. It has a vegetated island in the center. There they play hide and go seek and tag. She doesn't mind the prickly hollies because they make it harder for the one who is "it" to get them.

Next we passed two houses under construction. J told us that the bus stops at the corner and that sometimes when the kids are waiting for the bus to come they go and search for stuff and play with the sand in the construction area. She picked up sand (which is in clumps) and showed me how they throw it in the air. The corner is obviously a major spot. Not only is it the bus stop but also a meeting place as well as being "the entrance to the woods". She also likes the white flowering crepe Myrtle.

We walked the path down to the creek. J said she really never pays much attention to what's there - "it's just the path to get to the creek." She wanted to show me the "two islands". The first one, she calls "the peninsula" and the second one is the "2nd island". There she finds oyster shells. She said she doesn't come here a lot but sometimes, she comes here with her girlfriend B (whose backyard is up against the park). J isn't allowed to come here alone but she goes here with B. "It feels safe especially if B has her huge dog with her," J explained.

J said she isn't really interested in what's there (at the two islands) whether animals or plants, but sometimes they find things here - such as nails and stuff and she is excited about that. She doesn't collect them but hides them in the tall grass by the tracks. We turned back to the neighborhood. J walked really fast - she was worried that they would be late for dinner. Her cousin M showed much more interest in the environment than J.

I had met J. before, as I picked up the activity log. Then she was outside her house walking her cat on a leash around in the neighborhood. Then J had mentioned what a fun place the big hill is in winter. She had told me that "it is a perfect street hill because the tall trees cast shade and therefore the snow stays longer". "All the kids in the neighborhood gather there and ride sleds down. The grown-ups block the traffic so it's really safe," she added.

5. Notes from conversations with the children and their parent(s) during log reviews

- a) Mother: "This week was not a usual week. She had ballet rehearsals every day. Usually she has ballet lessons twice a week for one hour." The ballet classes are about three miles away. She also has piano lessons one a week and soccer on Saturday mornings for two to three hours because her sister has practice too." "Then she goes to the pool which is about ½ mile away." "It would be great if she could ride her bike to the pool." The cul-de-sac is a hangout. It is steep and good for scooters." "She has two sisters. They don't go far and use their walkie-talkies." "She worked on the log on her own without my assistance." "The maps were a bit blurry."
- b) Mother: "she has soccer practices in the fall and spring for about one and a half hour and softball practices in late spring for one hour." "It was hard to remember to do the log but it didn't take much time to do it." "it was more fun than homework but less fun than reading a magazine or book."
- c) Mother: this was a bit unusual week because he had dance recitals."
- d) Father: "The visuals were nice. Neat photo." "Kids don't want to spend more than 10 minutes on projects like this one and need help from parents." "She really likes the circle for play (*researcher's insertion*: the "circle" is the cul-de-sac in front of her home)." There are two entrances to this part of the neighborhood. Sidewalks are a "stress saver. They are very important." "The kids need a closer, flat field. A safe open space to play." "This is a good community. We like living here"
- e) Father: "She likes to walk her friend's house and walk the dog." "She liked to participate in the research but I had to remind her every day. It was short – not a burden." The aerial photo could have been better." Girl: "repeating the same thing was annoying."
- f) Father: "She is in an after school program until six o'clock and doesn't spend much time outside."
- g) Mother: "She was good about this project without being asked."
- h) Mother: "We need more public swimming pools close to the neighborhood." Child: "it was hard to understand at first. Dad helped me and started."
- i) Mother: "I thought this assignment was interesting but hard to remember. It helped me understand where he goes." "He likes going to the "walking logs" in the woods."
- j) Mother: "we just discovered this great path just outside the neighborhood. We go there four to five times a week. They bike but I walk with the dog and spend about an hour there."
- k) Mother: "We've lived here all her life." "We need more bike paths - the stream is great." "We really like participating in this research." *Researcher's insertion*: the child kept on saying "I'm pretty lazy."
- l) Mother: "I think I was more excited about this project than x but she like it too." "She is crazy with basketball (*researcher's note*: there were no basketball hoops visible). "She likes to play games every night." She is more active in late summer."
- m) Mother: "This was great. It was fun to write stuff down. The picture was a bit hard to work with."

Summary from Fieldtrips in the Traditional Neighborhood

Six children and one visiting child from the “traditional” neighborhood participated (four girls and two boys). Two of the girls were asked to participate because they had reported poor interest for the outdoor environment. Most of the children use the large backyards a lot for play. They also walk and ride around the neighborhood to friends’ houses. The cul-de-sacs are popular places to play although they are not designed for play. There the children play group games and ball games. They like playing in the woods too but most of them are not allowed to go there alone and some are not allowed to go there unless accompanied with an adult. This was especially true for the girls. The boys seem much freer to roam around the neighborhood and the surrounding woods than the girls. There are two playgrounds in the neighborhood, one on each side. Both are located in wooded areas not visible from the street. Interestingly, the children seem uninterested in playing there and some are not allowed to play there. The woods are a very rich play environment with many places of interest. The girls seem more interested collecting things such as flowers, shells, and man made objects in smaller areas whereas the boys go more around and use the woods more actively such as jumping in the creek, climbing rocks and ride on the dirt paths.

Table 4: Summary from fieldtrips in the traditional neighborhood

Extracts from fieldtrips in the traditional neighborhood							
Settings / participants	girl (10)	girl (10)	girl (10)	girl (9)	boy (11)	boy (11)	Σ
Private settings							
Backyard	x	x	x	x	x	x	6
Formal settings							
School grounds					x		1
Secondary street			x				1
Cul-de-sac	x	x	x			x	4
Around the neighborhood			x		x	x	3
Street corner			x				1
Street – hill (sledding)			x	x			2
Informal settings							
Woods (e.g. forts)	x	x		x	x	x	5
Pond					x		1
Stream/creek	x	x	x	x	x	x	6
Big rock / overhang					x		1
Informal paths				x	x	x	3
Bike ramps (woods)					x		1
Train tracks and bridge					x		1
Construction area			x				1
Indoor facilities							
Σ	4	4	8	5	10	6	

8.1.3 Fieldtrips in the “Co-housing neighborhood”

Two child-led fieldtrips were done in the co-housing neighborhood with three children.

1. Eight years old boy “J” and his 12 years old sister “A”

July 2002, 18:30, ½ hour

I met with the siblings at their house. Their mother was there too. We talked about the neighborhood and how much they like living there. They told me that soon they would be moving away and it would be hard to leave the neighborhood and their friends. A told me that she likes the neighborhood because she has many friends there and that they go places a lot. The first place they wanted to show me was the path. A told me that when she was little she used to ride scooters and bikes there. Now she uses it to blade. We walked to the pond and then around it. As we follow the path, she told me that she has a fort in the woods. She wanted to show me the dirt path they use to get to the street when they go to school. She said it is never the same. “When it rains it get very wet in here and we have to jump over the puddles.” “There are also all kinds of animals here” she said and mentioned frogs and birds. A told me that when they walk to school, they usually walk in a group and one of the parents walks with them. We walked back to the house. Outside the house is a small bonfire area. The siblings told me that it isn’t often used for bonfires but the kids often use it for all kinds of games. J got his gameboy and sat down on the lawn in front of the house. He told me that he likes the gameboy very much and that he likes to play it outside because then he sees when kids are around! As I was about to leave, their mother asked me if I would like to join them for a community grilling by the vegetable gardens. Grateful, I said I would very much like to do so. About ten adults and five children met at the grill area to grill hot dogs and eat together. At this point in the research I had already collected the data I needed so joining the community the grilling would not affect the results. The siblings proudly showed me the area and then started talking to the other kids there. The coming together was a friendly event. The people seemed to know each other well and it seemed like they do this kind of get together quite often.

2. Eight years old boy “K”

July 2002, 11:30, ½ hour

I met with K and his mother at their house. We sat down in their backyard which was very small, but had many outdoor playthings and a trampoline. We talked about his log. Our first destination was the Common house in the middle of the neighborhood. K seemed very excited about showing me the house. He told me how they use it to cook meals for the community and then lead me to the game room. He likes the game room very much and proudly shows me a TV, a foosball table and a chalkboard. He told me that he likes to play there with his friends or alone. Outside of the Common house is a nice little garden area with a paved surface in the middle. There, he explained, the children play all kinds of group games such as capture the flag.

From the Common house we walked along the paved pedestrian path in the middle of the neighborhood. We came to the far side of the neighborhood where the neighborhood street (fire lane about 700 ft. long) ends. He pointed to the fields across the street and explained that kids in the neighborhood are not allowed to enter the fields because the land doesn’t belong to the neighborhood – they are off limits and one cannot go there without supervision. K doesn’t show any interest in exploring the fields.

Bordering the fields and the neighborhood are woods. He pointed to the woods and said that there is a graveyard in there. When asked about it he told me that he had never been there and that he believes it is a myth. “The older kids go there,” he added “and some of them have a fort in the

woods.” When asked if he’d like to go there he showed little interest and said that it belongs to other children.

At the end of the street is a basketball rink. K said he likes playing basketball but he doesn’t use this court because it is too high and he also points out that the street isn’t for play.

From the far end of the neighborhood we go back to the paved pedestrian path. K led the way to the outdoor community barbeque area and the community vegetable area. He was obviously proud of the facilities but showed little interest in the flowers and vegetables. From there we walked on to the pond and he told me that he wasn’t allowed to go to the woods, the pond or lake unless accompanied by an adult. He showed no interest in walking around the pond or going to the trails across the pond that lead to the street and nearby neighborhoods. K is very much aware of neighborhood boundaries and his permissible range. When I asked him if he goes to the other neighborhoods, he told me that he doesn’t and that all his friends are here (K has been going to a private school but will start at the local school in the fall. This may explain why he doesn’t know any children in the adjacent neighborhoods).

Instead he turned around and walked back to the paved path. We walked to the playground. He likes the playground very much. He showed me around. “The swing-set is for younger kids” he explained. “I really like the hammock.” “You can flip it over and we use it for all kinds of games.” “If many kids are here we try to throw them off the hammock and then sometimes we play a game... who can take the most space in the hammock.” “I also like climbing the tree (not a very big tree but good for climbing) and good to have it here because it provides shade.”

“The kids like playing tetherball but I don’t like it so much,” he explained. He told me that he likes the obstacle course and dodge ball is his favorite. He got all excited when he started to talk about ball games and wanted to show me the grassy areas where they sometimes play ball. We walked to the grassy area and then he turned to me with a sad look on his face and told me that it needs to be mowed more often but some of the neighbors don’t like mowing too much. I noticed when he looked at me (checking for my interest) and when he saw I was carefully listening he started to smile and told me that he likes all exciting games and especially ball games that are fast games and running games. He also likes water-fights and he told me that the kids do that a lot in the neighborhood. As we headed back to his house, I saw a scooter lying in front of one of the homes and asked him if he likes to use the path for scootering. He looked at me (kind of amazed) and told me that scooters are not in fashion anymore – they were two years ago!

I asked K to list a few things he thought a neighborhood should have and he mentioned a dodge ball court, a swimming pool with a diving board, a baseball field, and a snow hill. He looked as if he were dreaming and told me how much he likes snowball fighting!

5. Notes from conversations with the children and their parent(s) during log reviews

- a) Mother: “We love living here.” “He had many friends of different ages.” “He is not allowed to leave the neighborhood unless with an adult.”
- b) Mother: “it was fun the first five days.” “It was difficult to recall if we forgot. “It was the end of school EOG test and a busy week.”

Summary from Fieldtrips in the Co-housing Neighborhood

Only three children participated in the co-housing neighborhood, two boys and one girl. The four children who participated in the log were asked if they would like to participate in this part of the study. One could not be reached. The girl was actually too old for this study but since she had lived in the neighborhood for a few years and knew it well she was asked to come along with her brother who actually was too young for this study. The third participant was also too young. All of them were enthusiastic to show me around and during the fieldtrips they pointed out many enlightening things but because the boys were only eight years old, different restrictions may apply which makes any neighborhood comparisons difficult. Nevertheless, the extracts from the fieldtrips provide thorough descriptions of the neighborhood.

The most striking findings, although not surprising, were that children's individual characteristics require a wide variety of opportunities for play and that it is very likely that the size of the neighborhood affects the exploration range. The neighborhood has many interesting destinations for children this age but as they get older there are fewer places of interest and they seek places further away such walking the trails and building forts in the woods. The most used setting (also observations) was the paved path inside the neighborhood. The children use it for wheeled activities, to go places and for active games. The playground, although very small is very popular place. There the children play on the play equipment but also make up games. It is also a meeting place. The children in this neighborhood have a good sense of neighborhood boundaries and parental restrictions.

Table 5: Summary from fieldtrips in the co-housing neighborhood

Extracts from fieldtrips in the co-housing neighborhood				
Settings / participants	girl (12)	boy (8)	boy (8)	Σ
<i>Private settings</i>				
Backyard		x	x	2
<i>Formal settings</i>				
Playground			x	1
Bon-fire area	x	x		2
Community grill	x	x	x	3
Vegetable gardens	x	x		2
Common area			x	1
Grassy area (ball games)			x	1
Paved path (e.g. to school)	x	x		2
Around the neighborhood	x	x		
<i>Informal settings</i>				

Table 5 (continued)

Woods (e.g. forts)	x			1
Pond	x	x	x	3
Informal path	x			1
<i>Indoor facilities</i>				
Common house			x	1
Σ	8	7	7	

8.2 Appendix II: Consent Forms

North Carolina State University

Request to participate in a doctorate research

"The Effects of Neighborhood Design on Children's Outdoor Physical Activities"

Principal investigator: Kristin Thorleifsdottir Faculty sponsor: Pr. Robin Moore

March, 2002

Dear parent(s)

My name is Kristin Thorleifsdottir and I am a PhD candidate in Community and Environmental Design at the College of Design, North Carolina State University. The purpose of this research is to seek information on how the outdoor environment in residential neighborhoods has influence on children's outdoor, physical activities. It is expected that the results will provide new information that can be used to propose priorities to promote children's outdoor activities through residential design and policy-making strategies that take children's needs into account. Your and your child's participation in this study is therefore very important. The results from this research are expected to be completed in spring 2003 and will be publicly available.

- If you are interested in participating in this study, I need you to sign this form (please keep a copy for your records) and your child to sign the child consent form. I also need you to complete the questionnaire enclosed in this package. Completing the questionnaire should not take more than 10 minutes. When I receive the documents, I will contact you by phone or e-mail and schedule an appointment to meet with you and your child to further explain the next step in the study.
- The next step is a nine-day activity log to be completed by your child. The activity log is a fun little book where your child will record his/her usual, everyday, out-of-school, physical activities in the neighborhood. In the log, your child will also trace on a map places visited and routes traveled. During these nine days, please encourage your child not to do anything out of the ordinary. Your child's honest recording is very important. It should take about 5-10 minutes every night to write in the log. Parental guidance in writing the log is highly encouraged. When your child has completed all nine days, I will pick up the log.
- I will also be doing a follow-up interview with some of the child participants (in the presence of an adult family member). If your child's name comes up, I will call you and schedule an appointment. The interview will take about 30 minutes. During this interview, I will ask your child a few questions about his/her log entries and other contextual information.

I believe that you and your child will find participating in this study interesting, educational, and fun. The participation in this study is totally voluntary and your child can withdraw from the study at any time. There is also no potential risk of any kind associated with this study. If your child does decide to withdraw from the study that will be all right, all I ask is that you let me know. I will not ask for any explanation.

All information provided will be kept absolutely confidential and securely locked in a filing cabinet in my office. No one, other than Professor Robin Moore and I, will know what your child writes. Some of the individual responses may be described and shown in the final dissertation report, but the name of the participants will not be disclosed. The information will be destroyed at the end of the study. If you or your child wishes to keep the activity log, please let me know and I will mail it to you.

After you have read the following statement and you and your child chose to participate in this study, please sign below.

"By signing this form, I agree that I understand my and my child's rights as a participant in this study. I have received a copy of this form, and I give permission to Ms. Kristin Thorleifsdottir and Professor Robin Moore to include my child's responses in their analysis of the results. All of my questions have been answered to my satisfaction, and I agree that my child may participate with the understanding that he/she may drop out at any time. I agree to participate in the study along with my child"

Parent signature:

Thank you very much for your participation in this survey. Both your and your child's participation is very important to this study. When I have received the package, I will contact you by phone and set up an appointment to deliver the log in person. It is therefore important that you write your name and phone number/ e-mail address below:

Also, if you have any questions, or you would like to discuss this research, please feel free to contact either Pr. Moore or me.

Again, thank you very much for your time and participation.

Sincerely,

Kristin Thorleifsdottir

Principal investigator
PhD candidate in Community and Environmental Design
College of Design
North Carolina State University
Campus Box 7701 / Brooks Hall
Raleigh, NC. 27695
Phone: (919) 368-5866
E-mail: kthorle@unity.ncsu.edu

Pr. Robin Moore

Faculty sponsor
Professor of Landscape Architecture
College of Design
North Carolina State University
Campus Box 7701 / Brooks Hall
Raleigh, NC. 27695
Phone: (919) 515 8345
E-mail: robin_moore@ncsu.edu

If you feel you have not been treated according to the descriptions in this form, or your rights as a research participant have been violated during the course of this project, you may contact Dr. Matt Zingraff, Chair of the NCSU IRB for the use of Human Subjects in Research Committee, at 919-513-1834 or the NCSU IRB office at 919-515-4514. The content of this survey is known to your neighborhood's Home Owners Association, but the Association is in no way associated with this study.

North Carolina State University

Request to participate in a doctorate research

"The Effects of Neighborhood Design on Children's Outdoor Physical Activities"

Principal investigator: Kristin Thorleifsdottir *Faculty sponsor:* Pr. Robin Moore

March, 2002

Hello!

I would like to invite you to participate in a study about children's outdoor activities and neighborhood environments.

I believe you will find participating in this study both interesting and fun. The study will provide very important information about how children use and experience the outdoor environment in different kinds of neighborhoods. The results will be used to design better neighborhoods that take kids needs into account. Your participation and ideas are therefore very important to this study.

- ❖ First, I would like to know if you are interested in participating in this study by signing this form. Your parent(s) also need to sign the parent consent form to give their permission for your participation and complete the questionnaire enclosed in this package. When you have decided that you would like to participate and your parents have given their permission, I will call your parent(s) and schedule an appointment to meet with you and your parent(s) to further explain the next step in the study, which is a nine-day-log you need to complete.
- ❖ The log is a little book where you write about your everyday, out-of-school, physical activities in your neighborhood. It should take you about 5-10 minutes every night to write in the log. You may need some assistance from your parent(s) or an older brother or sister. I need your honest recording of your usual activities. Therefore, please, during this time, do not do anything you usually would not do. When you have completed all nine days, I will pick up the log.
- ❖ I will also be doing a 30 minute interview and fieldtrip with some of the participating children. If you will be selected, I will call your parent(s) and schedule an appointment. Your parent(s) or another adult family member may be present. I will ask you a few questions about your log entries to make sure I understand everything correctly.

Your participation in this study is completely up to you and there is no potential risk of any kind associated with this study. You can drop out from the study at any time. If you do decide to drop out, that's all right, all I ask is that you let me know. I will not ask you to explain why.

The information you provide in this study will be kept absolutely confidential and securely locked in a filing cabinet in my office. No one, other than Professor Robin Moore and I will know what you write or say and your name will not be disclosed in the research report. Some of your responses may be described or shown in the report anonymously. The information will be destroyed at the end of the study. If you wish to keep the activity log, please let me know and I will mail it to you.

After you have read the following statement and if you chose to participate in this study, please sign below.

"By signing this form, I agree that I understand my rights as a participant in this study. I give permission to Ms. Kristin Thorleifsdottir and Professor Robin Moore to include my responses in their analysis of the results. All of my questions have been answered to my satisfaction, and I agree to participate with the understanding that I may drop out at any time."

Child's signature:

Date:

8.3 Appendix III: Parental Questionnaire

Parental Questionnaire Parents of 3rd, 4th, and 5th grade children



- * You may find some of the following questions sensitive. The purpose for asking these questions is to establish a demographic baseline to compare neighborhoods in this study. These questions are not intended to indicate any direct influences on your child's activities.
- * The use of the terms mother, father, and parent(s) refer to the child's primary caregiver(s), independent of biological and marital status.

1. Questions about your household (CIRCLE)

1. What is your relationship with the child participating in this survey?
(mother, father, other primary caregiver) If other, please explain:
2. What is/are the parents' age(s)?
Mother *(18-24, 25-34, 35-44, 45-64, 65 or older)*
Father *(18-24, 25-34, 35-44, 45-64, 65 or older)*
3. What is the parents' ethnicity?
Mother *(Caucasian, African American, Native American, Asian, Hispanic, other)*
Father *(Caucasian, African American, Native American, Asian, Hispanic, other)*
4. What is the parents' level of education?
Mother *(some high school or less, high school diploma or equivalent, some college, four-year college / professional degree, advanced degree)*
Father *(some high school or less, high school diploma or equivalent, some college, four-year college / professional degree, advanced degree)*
5. What is the total annual household income?
(less than \$15,000, \$15,000-\$24,999, \$25,000-\$49,999, \$50,000-\$74,999, \$75,000 or more)
6. What is the parents' marital status?
(married/living with a partner, single)?
7. If the child's biological parents do not live together, does your child spend some time with the other parent?
(no, rarely, weekends, a few days a week, weekdays) If other, please explain:
8. How many individuals are there in your household?
(2, 3, 4, 5, 6, more)
9. Do others, other than you, your spouse/partner, and your child(ren) live in the household? *(yes / no)*
If yes, please list:
10. How many children age 0-19 are there in your household?
(1, 2, 3, 4, 5, more) (# male, # female)

2. Questions about your neighborhood (CIRCLE)

1. How long has your family lived in this neighborhood?
(1 year or less, 2-5 years, 6-10 years, 11 years or more)
2. Where is the parents' place of work?
Mother *(stays at home, works from home, works outside home) (part time, full time)*
Father *(stays at home, works from home, works outside home) (part time, full time)*
3. If parent(s) work outside the home, how far from the home is the place of work?
Mother *(walking distance, not within walking distance)*
Father *(walking distance, not within walking distance)*
 - a) If place of work is within walking distance, do you walk to work?
Mother *(no, sometimes, always)*
Father *(no, sometimes, always)*
 - b) If parent(s) place of work is within walking distance, is it also within a safe walking distance for your child (e.g. your child can visit you at work)?
Mother *(yes / no)*
Father *(yes / no)*
4. On average, what would you consider a safe walking distance for your child?
Alone *(1/4 mile or less, 1/4-1/2 mile, 1/2-1 mile, 1 mile or more)*
With another child *(1/4 mile or less, 1/4-1/2 mile, 1/2-1 mile, 1 mile or more)*
With an older child *(1/4 mile or less, 1/4-1/2 mile, 1/2-1 mile, 1 mile or more)*
5. Did the neighborhood's outdoor environment affect your choice of a home?
(no, somewhat, very much)
6. Did the school district affect your choice of a home?
(no, somewhat, very much)
7. How attractive would you say your neighborhood is?
(not very attractive, fairly attractive, very attractive)
8. How friendly would you say your neighborhood is?
(not friendly, fairly friendly, very friendly)
9. How safe would you say your neighborhood is in terms of physical safety (e.g. your child getting hurt due to unsafe roads, hazardous play areas etc.)?
(not safe, fairly safe, very safe)

- b) Does your child play with the dog outdoors?
(*once a week, 2-3 times a week, 4-5 times a week, every day*)

17. Does your child participate in any organized, physical activities in your neighborhood? (*yes / no*)
If *yes*, please list the type, distance from neighborhood, months per year, and times per week (e.g. soccer, 5 min driving, 4 months per year, 3 times a week)?

18. Does your child participate in any organized, physical activities outside your neighborhood? (*yes / no*)
If *yes*, please list the type, distance from neighborhood, months per year, and times per week (e.g. soccer, 5 min driving, 4 months per year, 3 times a week)?

6. Questions about your child's health and personality characteristics (CIRCLE)

1. Does your child have any health problems? (*yes / no*)
If *yes*, does your child have any of the following:
 - a) *Emotional/behavioral problems such as attention deficiency, hyperactivity, communication deficiency, learning deficiency, other:*
 - b) *Physical problems such as physical disability, hearing, speech, vision, motor, obesity, seizures, diabetes, respiratory, other:*
 - c) *Any other health conditions not mentioned above (please specify)?*
2. If your child is physically disabled, please explain if and how it affects his/her outdoor, physical activities?
3. On average, during the school year, how many days do you think your child missed school because of health problems?
(*none, 1-2, 3-4, 5-6, 7-8, 9-10, more*)
4. Compared to other children of the same age and sex, would you say your child is
(*less active, average, more active*)?
5. How would you rate your child's capabilities in the following areas:
(*1= low capability, 5= average capability, 10= high capability*)
 - a) Spatial/ visual/ artistic/ imaginary
(*1, 2, 3, 4, 5, 6, 7, 8, 9, 10*)

- b) Logical/ mathematical/ analytical/ pattern
(*1, 2, 3, 4, 5, 6, 7, 8, 9, 10*)
- c) Musical / rhythmic/ auditory
(*1, 2, 3, 4, 5, 6, 7, 8, 9, 10*)
- d) Intrapersonal (self – awareness)
(*1, 2, 3, 4, 5, 6, 7, 8, 9, 10*)
- e) Interpersonal (working with others)
(*1, 2, 3, 4, 5, 6, 7, 8, 9, 10*)
- f) Bodily/kinesthetic (movement and functioning of the body)
(*1, 2, 3, 4, 5, 6, 7, 8, 9, 10*)
- g) Verbal/linguistic
(*1, 2, 3, 4, 5, 6, 7, 8, 9, 10*)
- h) Naturalistic (appreciation of nature)
(*1, 2, 3, 4, 5, 6, 7, 8, 9, 10*)

6. Compared to other children of the same age and sex, how reliable would you say your child is (e.g. when playing outdoors, can you trust that your child is where he/she said he/she would be)?
(*less reliable, average, more reliable*)
7. How well can you trust your child's judgement about
 - a) Physical safety (e.g. safety of roads and play spaces)?
(*not well, fairly well, very well*)
 - b) Social safety (e.g. intentions of other people)?
(*not well, fairly well, very well*)
8. Compared to other children of the same age and sex, how well does your child get along with other children?
(*not so well, average, very well*)

10. How safe would you say your neighborhood is in terms of social crime (e.g. your child being hurt by another person while being outdoors)?
(not safe, fairly safe, very safe)
11. Do you, in general, like to be outdoors in your neighborhood?
(not very much, somewhat, very much)
12. How often do you personally do recreational activities in your neighborhood?
(never, rarely, 1-3 days a week, 4-6 days a week, daily)
13. Please list all recreational activities you personally do on a regular basis in your neighborhood (e.g. jog, walk, stroll, swim, tennis, workout at the gym)?
14. Please list all recreational activities you personally do on a regular basis outside your neighborhood and how often?
15. How often do you do recreational activities with your child in your neighborhood?
(never, rarely, 1-3 days a week, 4-6 days a week, daily)
16. Please list all recreational activities you do with your child in your neighborhood?
17. Please list all recreational activities you do with your child outside your neighborhood and how often (e.g. hiking, 2 hours, 3 times a year)?
18. How would you rate the physical environment in your neighborhood in terms of opportunities for children's outdoor activities?
(poor, fair, very good)
19. Are there any places in your neighborhood your child likes, but you consider 'undesirable' for your child (e.g. too far or unsafe, unless accompanied by an adult or an older sibling etc.)? (yes / no)
If yes, please list and explain:

3. Questions about your yard (CIRCLE)

1. What is the approximate size of your yard?
(1/4 acre or less, 1/4-1/2 acre, 1/2-3/4 acre, 3/4 acre or more)
2. Is your yard fenced in?
(no, the back yard, the front yard, both back and front yard)
3. From your yard, do you have an immediate access to natural areas: (yes / no)

If yes, what kind (woods, water source, hill, meadow etc.):

If yes, do you allow your child to go there
(alone, with other children, with an adult, no)?

4. Do you have any play equipment in your yard (e.g. swing set, basketball hoop, soccer goals, tree/club house, swimming pool or other water features for play, trampoline etc.)? (yes / no)
If yes, please list:
5. Please list any special features in your yard that are attractive to your child (e.g. open lawn for games, water features, vegetable garden, piles of dirt or sand, bird houses and/or feeders, large trees to climb, interesting plants, woods)?
6. Did the quality of your yard, in terms of opportunities for children's outdoor activities, affect your choice of a home?
(no, somewhat, very much)

4. Questions about your child's school and journey to school (CIRCLE)

1. Is your child home-schooled? (yes / no) If yes, please go to question # 7.
2. Does your child walk/bike to school? (yes / no)
If yes:
 - a) How far does your child walk/bike?
(1/4 mile or less, 1/4-1/2 mile, 1/2-1 mile, farther)
 - b) Who accompanies your child to school?
(no one, other children, an adult)
 - c) On average, at what time does your child get home from school?
(3 p.m. or earlier, 3-3:30 p.m., 3:30-4 p.m., 4:30-5 p.m., later)
3. Does your child ride the school bus to and from school? (yes / no)
If yes:
 - a) How far from the home does the bus stop?
(right outside the house, 1/4 mile or less, 1/4-1/2 mile, more)
 - b) On average, how much time does your child spend on the school bus every day?
(10 min or less, 10-20 min, 20-30 min, 30-40 min, 40 min or more)
 - c) At what time does the school bus bring your child back?
(3 p.m. or earlier, 3-3:30 p.m., 3:30-4 p.m., 4:30-5 p.m., later)
4. Is your child a car-rider to and from school? (yes / no)

If yes:

- a) On average, how much time does your child spend riding to and from school every day?
(10 min or less, 10-20 min, 20-30 min, 30-40 min, 40 min or more)
- b) On average, at what time does your child get home from school?
(3 p.m. or earlier, 3-3:30 p.m., 3:30-4 p.m., 4:30-5 p.m., later)

5. Does your child attend an after-school program? (yes / no)

If yes:

- a) Is the after-school program at your child's school? (yes / no)
- b) Is the after school program in your neighborhood? (yes / no)
- c) Does the after school program offer any outdoor activities?
(no, only when weather allows, once a week, a few times a week, everyday, unlimited access to outdoor areas)
- d) How much time does your child spend outdoors in the after school program?
(none, 10-20 min, 20-40 min, 40-60 min, unlimited)
- e) On average, at what time does your child get home from the after school program?
(3 p.m. or earlier, 3-3:30 p.m., 3:30-4 p.m., 4:30-5 p.m., 5:30-6 p.m., 6:30-7 p.m., later)
- f) How does your child get home from the after school program?
(walk/bike, school bus, car)

6. Does your child stay somewhere else after school? (yes / no)

If yes, please explain:

7. On average, how much outdoor recess does your child have at school every day?
(30 min or less, 30-60 min, more)
8. How many times a week does your child have physical education?
(never, once, twice, three times, every day)

5. Questions about your child's activities (CIRCLE)

1. On average, how much time does your child spend doing homework every day?
(20 min or less, 20-40 min, 40-60 min, more)
2. On average, when does your child do his/her homework?
(between 3-4 p.m., 4-5 p.m., 5-6 p.m., 6-7 p.m., later)
3. On average, how much time does your child spend watching television or videos on school days?
(0-20 min, 20-40 min, 40-60 min, 1-1:30 hr, 1:30-2 hr, 2 hr or more)

4. On average, how much time does your child spend watching television or videos per day on weekends?
(0-30 min, 30-60 min, 1-2 hr, 2-3 hr, 3-4 hr, 4 hr or more)

5. On average, how much time does your child spend playing computer games (Play Station, Nintendo, Game Boy etc.) on schooldays?
(0-30 min, 30-60 min, 1-2 hr, 2-3 hr, 3-4 hr, 4 hr or more)

6. On average, how much time does your child spend playing computer games (Play Station, Nintendo, Game Boy etc.) per day on weekends?
(0-30 min, 30-60 min, 1-2 hr, 2-3 hr, 3-4 hr, 4 hr or more)

7. Do you encourage your child to be outdoors on schooldays? (yes / no)
If yes, on average, for how long each day?
(1/2 hr or less, 1/2-1 hr, 1-2 hr, 2 hr or more)

8. Do you encourage your child to be outdoors on weekends? (yes / no)
If yes, on daily average, for how long time?
(1 hr or less, 1-2 hr, 2-3 hr, 3-4 hr, 4 hr or more)

9. On average, how late do you allow your child to stay outside during schooldays?
(5-6 p.m., 6-7 p.m., 7-8 p.m., later)

10. On average, how late do you allow your child to stay outside on weekends?
(5-6 p.m., 6-7 p.m., 7-8 p.m., later)

11. How many friends would you estimate your child has in the neighborhood?
(none, 1, 2-3, 4-5, more)

12. Do your child's friends live within a child's safe walking/biking distance?
(no, some, most)

13. Do you normally allow your child to bring friends home? (yes / no)

14. Please list your child's outdoor playthings (e.g. roller skates/blades, bicycle, scooter, skate board, balls, jump rope, stilts, kite, frisbee, snowboard, sled, equipment for studying wildlife)?

15. Does your child have (rain gear, snow gear)?

16. Does your family have a dog? (yes / no)

If yes,

- a) Does your child walk the dog? (yes / no)

If yes,

- i. How often does your child walk the dog?
(once a week or less, 2-3 times a week, 4-5 times a week, every day)
- ii. How far does your child walk the dog?
(1/4 mile or less, 1/4-1/2 mile, 1/2-1 mile, farther)

8.4 Appendix IV: Children's Nine-day Activity Log

<p>This page is for researcher's notes:</p> <p>Thanks for your help!</p> <p>No.:</p>	<p>9-DAY-LOG</p> <p>OUT-OF-SCHOOL OUTDOOR PHYSICAL ACTIVITY</p>  <p>Name: _____ Female / male</p> <p>Age: _____ Weight: _____</p> <p>Neighborhood: _____ Height: _____</p>
---	--

Date: Sunday, April 20, 2002

Weather: sunny, calm, 75°

Time you got home from school? 1:30

Was today a typical day? (Yes / No)

Please tell us about your **out-of-school, outdoor physical activities**.

As **detailed** as you can, please report the type of outdoor activities, the places you visited (location), and for how long you did each activity. Remember to use the same numbers you use on the map.

1. Activity: jogging
Location: friend's house
Time: 3 min

2. Activity: walking
Location: friend's house
Time: 2 min

3. Activity: walking
Location: home
Time: 2 min

4. Activity: playing soccer
Location: my backyard
Time: 20 min

5. Activity: climbing trees
Location: my backyard
Time: 5 min

6. Activity: swinging
Location: my backyard
Time: 3 min

7. Activity: walking
Location: neighbor's house
Time: 1 1/2 min

8. Activity: walking
Location: home
Time: 3 min

9. Activity:
Location:
Time:

10. Activity:
Location:
Time:

11. Activity:
Location:
Time:

12. Activity:
Location:
Time:

13. Activity:
Location:
Time:

14. Activity:
Location:
Time:

15. Activity:
Location:
Time:

16. Activity:
Location:
Time:

General instructions:

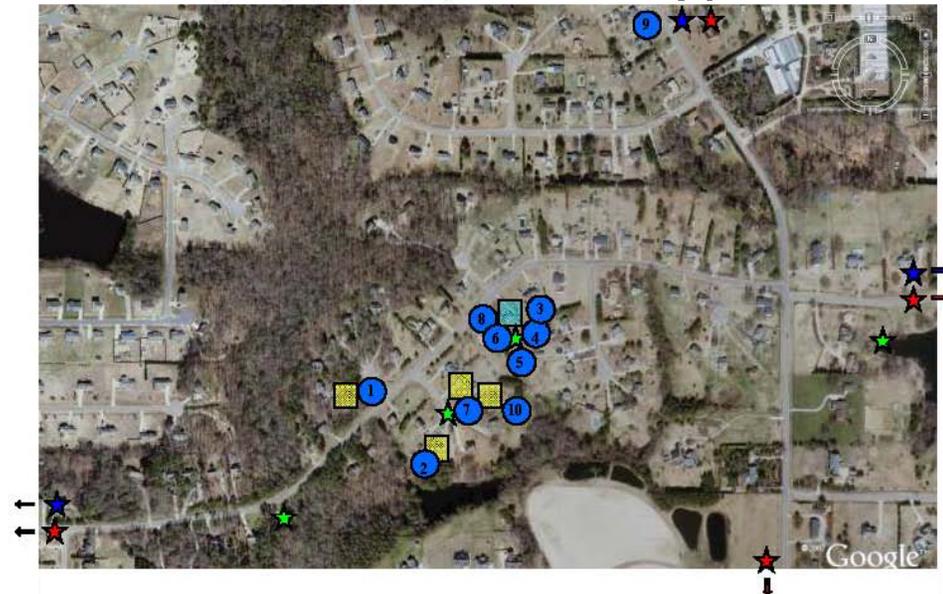
1. Please write in the activity log before going to bed each night.
2. You may need your parent's (or an older sibling's) help.
3. If you have a **watch**, please use it to make approximate time measurements of your activities.
4. Please use fine pens or markers that do not bleed. It may be a good idea to sketch first with a pencil



Instructions for maps:

1. For all maps, find your house and color it **blue**.
2. For all maps, find your friends' houses and color them **yellow**.
3. For all maps, circle the places you went to with **blue** and give them a **number**. Remember that this number is the same as on the left.
4. For all maps, trace how you got to these places with **red**.
5. For all maps, if you did any outdoor physical activities outside this map, such as soccer practice, swimming, or walking in a park, mark with a **red arrow** where you left the neighborhood, give it a **number**, and fill in the list on the left.
6. On the *Sunday map only*, please mark in with a **blue star** the places you have been the furthest **without** an adult.
7. On the *Sunday map only*, please mark in with a **red star** the places you have been the furthest **with** an adult.
8. On the *Sunday map only*, please mark your favorite outdoor places with a **green star**.

Please remember to honestly record your usual outdoor physical activities!



Date:
 Weather:
 Time you got home from school?:
 Was today a typical day? (Yes/No)

Please tell us about your **out-of-school, outdoor physical activities**.
 As **detailed** as you can, please report the type of outdoor activities, the
 places you visited (location), and for how long you did each activity.
 Remember to use the same numbers you use on the map. →

- | | |
|------------------------------------|-------------------------------------|
| 1. Activity:
Location:
Time: | 9. Activity:
Location:
Time: |
| 2. Activity:
Location:
Time: | 10. Activity:
Location:
Time: |
| 3. Activity:
Location:
Time: | 11. Activity:
Location:
Time: |
| 4. Activity:
Location:
Time: | 12. Activity:
Location:
Time: |
| 5. Activity:
Location:
Time: | 13. Activity:
Location:
Time: |
| 6. Activity:
Location:
Time: | 14. Activity:
Location:
Time: |
| 7. Activity:
Location:
Time: | 15. Activity:
Location:
Time: |
| 8. Activity:
Location:
Time: | 16. Activity:
Location:
Time: |

On this map please

1. Find your house and color it **blue**.
2. Color your friends' houses **yellow**.
3. Circle the places you went to with **blue** and give them a **number**.
Remember that this number is the same as on the left. →
4. Trace how you got to these places with **red**. →

*If you did any outdoor physical activities outside this map, such as soccer practice, swimming, or walking in a park, mark with a **red arrow** where you left the neighborhood, give it a **number**, and fill in the list on the left. →

Saturday



Date:

Weather:

Time you got home from school?

Was today a typical day? (Yes / No)

Please tell us about your **out-of-school, outdoor physical activities**. As **detailed** as you can, please report the type of outdoor activities, the places you visited (location), and for how long you did each activity. Remember to use the same numbers you use on the map. →

- | | |
|--------------|---------------|
| 1. Activity: | 9. Activity: |
| Location: | Location: |
| Time: | Time: |
| 2. Activity: | 10. Activity: |
| Location: | Location: |
| Time: | Time: |
| 3. Activity: | 11. Activity: |
| Location: | Location: |
| Time: | Time: |
| 4. Activity: | 12. Activity: |
| Location: | Location: |
| Time: | Time: |
| 5. Activity: | 13. Activity: |
| Location: | Location: |
| Time: | Time: |
| 6. Activity: | 14. Activity: |
| Location: | Location: |
| Time: | Time: |
| 7. Activity: | 15. Activity: |
| Location: | Location: |
| Time: | Time: |
| 8. Activity: | 16. Activity: |
| Location: | Location: |
| Time: | Time: |

On this map please

1. Find your house and color it **blue**.
2. Color your friends' houses **yellow**.
3. Circle the places you went to with **blue** and give them a **number**. Remember that this number is the same as on the left. ↖
4. Trace how you got to these places with **red**. ↖

*If you did any outdoor physical activities outside this map, such as soccer practice, swimming, or walking in a park, mark with a **red arrow** where you left the neighborhood, give it a **number**, and fill in the list on the left. ↖

Sunday



Date:
 Weather:
 Time you got home from school?
 Was today a typical day? (Yes / No)

Please tell us about your **out-of-school, outdoor physical activities**.
 As **detailed** as your can, please report the type of outdoor activities, the
 places you visited (location), and for how long you did each activity.
 Remember to use the same numbers you use on the map. →

- | | |
|------------------------------------|-------------------------------------|
| 1. Activity:
Location:
Time: | 9. Activity:
Location:
Time: |
| 2. Activity:
Location:
Time: | 10. Activity:
Location:
Time: |
| 3. Activity:
Location:
Time: | 11. Activity:
Location:
Time: |
| 4. Activity:
Location:
Time: | 12. Activity:
Location:
Time: |
| 5. Activity:
Location:
Time: | 13. Activity:
Location:
Time: |
| 6. Activity:
Location:
Time: | 14. Activity:
Location:
Time: |
| 7. Activity:
Location:
Time: | 15. Activity:
Location:
Time: |
| 8. Activity:
Location:
Time: | 16. Activity:
Location:
Time: |

On this map please

1. Find your house and color it **blue**.
2. Color your friends' houses **yellow**.
3. Circle the places you went to with **blue** and give them a **number**.
Remember that this number is the same as on the left. ↙
4. Trace how you got to these places with **red**. ↙

Monday



*If you did any outdoor physical activities outside this map, such as soccer practice, swimming, or walking in a park, mark with a **red arrow** where you left the neighborhood, give it a **number**, and fill in the list on the left. ↙



Date:
 weather:
 Time you got home from school?
 Was today a typical day? (Yes / No)

Please tell us about your **out-of-school, outdoor physical activities**.
 As **detailed** as your can, please report the type of outdoor activities, the
 places you visited (location), and for how long you did each activity.
 Remember to use the same numbers you use on the map. →

- | | |
|------------------------------------|-------------------------------------|
| 1. Activity:
Location:
Time: | 9. Activity:
Location:
Time: |
| 2. Activity:
Location:
Time: | 10. Activity:
Location:
Time: |
| 3. Activity:
Location:
Time: | 11. Activity:
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| 4. Activity:
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| 6. Activity:
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Time: | 14. Activity:
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| 7. Activity:
Location:
Time: | 15. Activity:
Location:
Time: |
| 8. Activity:
Location:
Time: | 16. Activity:
Location:
Time: |

On this map please

1. Find your house and color it **blue**.
2. Color your friends' houses **yellow**.
3. Circle the places you went to with **blue** and give them a **number**.
Remember that this number is the same as on the left. ↙
4. Trace how you got to these places with **red**. ↙

*If you did any outdoor physical activities outside this map, such as soccer practice, swimming, or walking in a park, mark with a **red arrow** where you left the neighborhood, give it a **number**, and fill in the list on the left. ↙

Tuesday



Date:
 Weather:
 Time you got home from school?
 Was today a typical day? (Yes / No)

Please tell us about your **out-of-school, outdoor physical activities**.
 As **detailed** as you can, please report the type of outdoor activities, the
 places you visited (location), and for how long you did each activity.
 Remember to use the same numbers you use on the map. →

- | | |
|------------------------------------|-------------------------------------|
| 1. Activity:
Location:
Time: | 9. Activity:
Location:
Time: |
| 2. Activity:
Location:
Time: | 10. Activity:
Location:
Time: |
| 3. Activity:
Location:
Time: | 11. Activity:
Location:
Time: |
| 4. Activity:
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Time: | 12. Activity:
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| 5. Activity:
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| 6. Activity:
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Time: | 14. Activity:
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| 7. Activity:
Location:
Time: | 15. Activity:
Location:
Time: |
| 8. Activity:
Location:
Time: | 16. Activity:
Location:
Time: |

On this map please

1. Find your house and color it **blue**.
2. Color your friends' houses **yellow**.
3. Circle the places you went to with **blue** and give them a **number**.
Remember that this number is the same as on the left. →
4. Trace how you got to these places with **red**. →

*If you did any outdoor physical activities outside this map, such as soccer practice, swimming, or walking in a park, mark with a **red arrow** where you left the neighborhood, give it a **number**, and fill in the list on the left. →

Wednesday



Date _____
 Weather _____
 Time you got home from school? _____
 Was today a typical day? (Yes/No) _____

Please tell us about your **out-of-school, outdoor physical activities**.
 As **detailed** as you can, please report the type of outdoor activities, the places you visited (location), and for how long you did each activity.
 Remember to use the same numbers you use on the map. →

- | | |
|------------------------------------|-------------------------------------|
| 1. Activity:
Location:
Time: | 9. Activity:
Location:
Time: |
| 2. Activity:
Location:
Time: | 10. Activity:
Location:
Time: |
| 3. Activity:
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Time: | 11. Activity:
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| 4. Activity:
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Time: | 14. Activity:
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| 7. Activity:
Location:
Time: | 15. Activity:
Location:
Time: |
| 8. Activity:
Location:
Time: | 16. Activity:
Location:
Time: |

On this map please

1. Find your house and color it **blue**.
2. Color your friends' houses **yellow**.
3. Circle the places you went to with **blue** and give them a **number**.
Remember that this number is the same as on the left. ↙
4. Trace how you got to these places with **red**. ↙

*If you did any outdoor physical activities outside this map, such as soccer practice, swimming, or walking in a park, mark with a **red arrow** where you left the neighborhood, give it a **number**, and fill in the list on the left. ↙

Thursday



Date:
 Weather:
 Time you got home from school?
 Was today a typical day? (Yes / No)

Please tell us about your **out-of-school, outdoor physical activities**.
 As **detailed** as your can, please report the type of outdoor activities, the places you visited (location), and for how long you did each activity.
 Remember to use the same numbers you use on the map. →

- | | |
|------------------------------------|-------------------------------------|
| 1. Activity:
Location:
Time: | 9. Activity:
Location:
Time: |
| 2. Activity:
Location:
Time: | 10. Activity:
Location:
Time: |
| 3. Activity:
Location:
Time: | 11. Activity:
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| 4. Activity:
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| 7. Activity:
Location:
Time: | 15. Activity:
Location:
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| 8. Activity:
Location:
Time: | 16. Activity:
Location:
Time: |

On this map please

1. Find your house and color it **blue**.
2. Color your friends' houses **yellow**.
3. Circle the places you went to with **blue** and give them a **number**.
Remember that this number is the same as on the left. →
4. Trace how you got to these places with **red**. →

*If you did any outdoor physical activities outside this map, such as soccer practice, swimming, or walking in a park, mark with a **red arrow** where you left the neighborhood, give it a **number**, and fill in the list on the left. →

Friday



Not to scale

8.5 Appendix V: Classification of Neighborhood Settings

Table 6: Classification of neighborhood settings

1. PRIVATE NEIGHBORHOOD SETTINGS
1.1 Child’s yard: front, back, or side yards, driveways, lawns, vegetation, porches, vegetation, specific play spaces, decks, private swimming pools
1.2 Friend’s yard: front, back, or side yards, driveways, lawns, vegetation, porches, vegetation, specific play spaces, decks, private swimming pools
1.3 Child’s house: indoors
1.4 Friend’s house: indoors
2. FORMAL NEIGHBORHOOD SETTINGS
2.1 Open space (confined settings):
2.1.1 Parks and formal play areas: community parks, village greens, neighborhood parks, mini parks, vest-pocket parks, designated play areas (playgrounds), graveyards, community vegetable garden, outdoor movie theaters/amphitheaters, community fire pit areas, church yards, formal camp sites etc.
2.1.2 School grounds
2.1.3 Recreational/sport fields: recreation parks, tennis courts (also at private clubs), skate parks, ball parks, horse back riding farms, golf courses, golf driving ranges
2.1.4 Outdoor swimming pools
2.2 Streets and formal paths (linear settings)
2.2.1 Primary and secondary streets (collector roads, main streets and residential streets)
2.2.2 Tertiary streets: back-alleys, woonerven, cul-de-sacs, driveways, gravel and dirt roads etc.
2.2.3 Specific street settings: ramps, crosswalks, street corners, dropped curbs, narrower turns, widened sidewalks for pedestrian activities, parking lots, around street furniture (mailboxes, benches, streetlights etc.), flower beds and special vegetation or semi-public gardening spaces etc.
2.2.4 Pedestrian streets: outdoor shopping areas, downtown walking, pedestrian malls etc.
2.2.5 Railroad tracks
2.2.6 Streets good for sledding
2.2.7 Water features: fountains, pools, wading pools (not swimming pools) etc.
2.2.8 Pedestrian paths: sidewalks (along street), widened sidewalks, greenways, under/over passes, crosswalks, and in-between, cycle tracks etc.
2.2.9 Other: enclosed smaller spaces for privacy, hide-outs, spying etc., decks, porches, and balconies, courtyards, plazas, fire pits, squares, circuses, roundabouts, community mail boxes etc.
2.2.10 Around neighborhood: loops, blocks etc.
3. INFORMAL NEIGHBORHOOD SETTINGS

Table 6 (continued)

- 3.1 Open space (confined settings)
 - 3.1.1 Natural areas: woods, fields, wildlife habitats, places with loose/graspable features (branches, rocks, dirt, sand, leaves, shells etc.), old cemeteries, play fields, informal camp sites etc.
 - 3.1.2 Natural areas with water body: lakes, ponds, streams (rivers, creeks), beaches, ditches, swales, swampy areas, muddy areas etc.
 - 3.1.2 Other: 'left-over' spaces, 'in-between' spaces, ruins, rocks, cliffs, storage areas (garbage, and dumpsites), construction sites, culverts, storm drains etc. etc.
- 3.2 Paths (linear settings): cut-across paths, in-between paths, nature trails, dirt bike paths, riding trails etc.

4. INDOOR NEIGHBORHOOD FACILITIES

- 4.1 Special sport/recreational facilities: school gym
- 4.2 Schools: daycare centers, elementary schools, middle schools
- 4.3 Retail and commercial facilities: neighborhood café, restaurant etc.
- 4.4 Community centers
- 4.5 Religious gathering places
- 4.6 Museums
- 4.7 Movie theaters
- 4.8 Country clubs

8.6 Appendix VI: Classification of Physical Activities

Table 7: Classification of physical activities

LEVEL 1: LIFESTYLE ACTIVITIES

1.1. ACTIVE PLAY

A leisure activity that is undertaken purely for the sake of enjoyment or amusement and has no other objective (free play).

1.1.1 Active play (individual): walking, jogging, running/racing, swinging, horseshoe pitching, croquet, frisbee, kiting, archery, carpentry, outdoor art such as painting, coloring, chalking and drawing, play an instrument, play with marbles, playing cards, playing dolls, playing with action figures, play with tent, bon fire activities, pulling loose equipment, street/sidewalk/yard sale (lemonade, 2nd hand toys etc.), horseback riding, track up /untrack horses, play with dog, cat, training dog, jumping, climbing, climbing a tree, dancing, carpentry, throwing sticks, ball, frisbee etc., play with a ball, chase, hop scotch, riding zipper, zip line, play on manufactured play equipment, hanging, trampoline, rock climbing, jump rope.

1.1.2 Activities w/ wheels: biking, dirt biking, scootering, roller skating/blading, skateboarding, scootering etc.

1.1.3 Water activities: pool play, beach play, play with water guns, squirt guns, sailing a small boat, puddeling, canoeing, kayaking, fishing (jigging), run through sprinklers, play with hose, throwing water balloons, mud slide, water war etc.

1.1.4 Snow activities: throwing snow balls, downhill skiing, cross country skiing, snowboarding and sledding, sliding, building snow people, figure skating (outside), ice hockey (outside) etc.

1.1.5 Active Group Play: *games with rules* (competition games) are a) *games with an object:* horseshoe pitching, croquet, frisbee, badminton, touch football/ flag football, capture the flag etc., b) *ball games:* baseball/softball, volleyball, whiffleball, shooting hoops, wall ball, ping pong, catch, field hockey, stickball, kickball, basketball, football, soccer, tennis, lacross, speed roller skating/blading w/ball etc., and c) *games without an object* such as many street games, field games and yard games: truth-or-dare, hide-and-go-seek, scavenger hunt, cowboys and Indians, cops and robbers, ghost in the graveyard, tag, freeze tag, 4 square, chase, play fighting, block war, taps etc.

1.2 DOMESTIC CHORES

Domestic chores are responsibilities such as yard work, taking out the trash, running errands in the neighborhood such as walk to the grocery store, walking the dog etc. walk the dog/cat, play with dog, feed animals, babysitting (srtolling), recycling, pick up the mail, fetch the newspaper etc., miscellaneous yard work such as weeding, watering plants, picking up trash, seeding, planting, pruning, collect wood for bon fire, raking, pushing a lawn mower, fencing, shoveling dirt, gravel etc., help with preparing food, deliver newspapers flyers etc.

1.3 TRAVEL BETWEEN PLACES

Travel between point A to point B (as means of transportation), the physical activity is not the focus of the activity e.g., walk, jog, run, bike, scooter, roller skate or blade between places

1.4 EXPLORATION

Physical activities that take place in both natural and man made settings and have an unintentional or unclear focus/goal. In the category "rest and inactivity" the goal is intentional. Exploration activities are e.g., hanging around, wandering off, "on the way" activities, to venture beyond, seeking adventures or discoveries etc.

Table 7 (continued)

<p>1.5 NATURE ACTIVITIES</p> <p>Physical activities that take place in natural settings such as woods, fields, creek, lake or other natural water source. Nature activities are e.g., walking in natural settings, hiking, horseback riding in nature, nature exploration such as following an animal, search for traces of or trace footprints etc., play in natural areas such as making mud sculptures in a creek, catching butterflies, bugs, fireflies, ladybugs, catching frogs and tadpoles, fishing, camping, collecting flowers, rocks, leaves, shells, bugs, berries, mountain biking, dirt biking, climbing trees, rock climbing, working on a nature project for school, dipping in natural water source, swinging in trees in the woods, building a fort in the woods, camping out etc.</p>
<p>LEVEL 2: Cardiovascular Activities (active aerobics)</p>
<p>2.1 Recreation</p> <p>Intentional physical activities such as walking, jogging, running, biking, hiking done for recreational purposes. Physical activities which can be done for relatively long periods of time without stopping are generally considered to be aerobic in nature.</p>
<p>2.2 Sports (organized activities)</p> <p>Physical activities intentionally done to increase stamina such as organized and/or competitive sports. During school-age, largest numbers of children are involved in organized sports for the purpose of recreation, competition, socialization and play. More of the time will be spent will be dedicated to skill learning and playing games rather than conditioning.</p>
<p>2.2.1. Individual sports</p> <p>Individual sports are organized games based on competition between individuals or self-competition: swimming, track & field, golf, badminton (singles), martial arts, kayaking, rowing, sail boating, water skiing, speed skating, speed roller skating/blading, figure skating, bicycling, ballet, dance, yoga, and calisthenics.</p>
<p>2.2.2. Team sports</p> <p>Team sports or organized games which increase cooperation between individuals and compete with other teams: badminton (doubles), softball, baseball, soccer, basketball, football, tennis, field hockey, swimming, polo, ice hockey etc.</p>
<p>LEVEL 3: Flexibility and Strength Exercises</p> <p>Exercises and physical activities designed and performed specifically to increase the length of muscles and connective tissues and to improve range of motion and activities that require children to move and lift their own body weight. This type of activity is done for the purpose of the activity such as yoga stretches to increase flexibility and weight lifting to improve strength but also as part of practicing organized sports such as warm ups in the beginning of practice and stretching after practice.</p>
<p>LEVEL 4: Rest & Inactivity</p> <p>Solitary and sedentary endeavors such as reading, talking on the phone, listening to music, eating, and watching television, sitting outside, laying outside, sunbathing, standing still, being carried, watching an outdoor game such as baseball, football, soccer etc. with minimum physical activity, eating outside etc.</p>

8.7 Appendix VII: Tables

Table 8: Participant population

a. Total child neighborhood population (neighborhood associations listing, school records)																		
	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
3 rd grade	19	45	17	33	36	39	7	29	4	40	11	32	2	40	5	100	7	70
4 th grade	14	33	13	25	27	29	3	13	0	0	3	9	2	40	0	0	2	20
5 th grade	8	19	20	39	28	30	9	38	3	30	12	35	1	20	0	0	1	10
Missing data	1	2	1	2	2	2	0	0	0	0	8	24	0	0	0	0	0	0
Σ	42	100	51	100	93	100	24	100	10	100	34	100	5	100	5	100	10	100
b. Total child population reached (of total neighborhood child population)																		
	31	74	36	71	67	72	20	83	9	90	29	85	5	100	5	100	10	100
c. Questionnaires delivered to (of population reached)																		
	28	90	26	72	54	81	18	90	8	89	26	90	3	60	5	100	8	80
d. Questionnaires returned (of population delivered to)																		
	20	71	9	35	29	54	16	89	7	88	23	88	2	67	4	80	6	75
e. Logs delivered (of questionnaires returned)																		
	15	75	8	89	23	79	15	94	6	86	21	91	1	50	3	75	4	67
f. Logs returned (of logs delivered)																		
	15	100	8	100	23	100	15	100	6	100	21	100	1	100	3	100	4	100
g. Fieldtrips (of logs returned)																		
	4	27	4	50	8	35	4	27	2	33	6	29	1	100	2	67	3	75

♂= male sign, ♀= female sign, %= percentage, Σ=total

Table 9: Children’s health

a. Children’s weight																			
	<i>MIX</i>					<i>TRAD</i>					<i>COH</i>								
	♀	x	♂	x	Σ	x	♀	x	♂	x	Σ	x	♀	x	♂	x	Σ	x	
<i>N</i>	15		8		23		15		6		21		1		3		4		
3 rd grade	6	66	4	69	10	67	5	68	3	76	8	72	0	0	3	55	3	55	
4 th grade	6	76	2	84	8	70	6	73	1	61	7	66	0	0	0	0	0	0	
5 th grade	3	96	2	82	5	89	4	96	2	79	6	87	1	70	0	0	1	70	
x		79		78		75		79		72		75		70		55		63	
b. Children’s height																			
3 rd grade	6	51	4	53	10	52	5	51	3	50	8	50	0	0	3	50	3	50	
4 th grade	6	53	2	49	8	51	6	53	1	54	7	53	0	0	0	0	0	0	
5 th grade	3	59	2	56	5	57	4	60	2	58	6	59	1	59	0	0	1	59	
x		35		34		34		35		35		34		0		50		25	
c. Does your child have any health problems that might affect his ore her outdoor physical activities? (Q6.1)																			
<i>N</i>					29						23							6	
No					23	79					20	87						5	83
Yes					6	21					3	13						1	17
d. If yes, does your child have any of the following problems (Q6.2)																			
Emotional/behavioral					3	50					1	25						0	0
Physical					2	33					1	25						1	10
Other					1	17					1	25						0	0

♂= male sign, ♀= female sign, %= percentage, Σ=total, x= average

Table 10: Demographic information

a. Participating parent’s relationship with child (Q1.1)																		
	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
	24	83	5	17	29	50	18	78	5	22	23	40	5	83	1	17	6	10
b. Parents’ age? (Q1.2)																		
25-34	1	3	1	3	2	3	1	4	0	0	1	2	0	0	1	17	1	8
35-44	20	69	13	45	33	57	12	52	11	48	23	50	2	33	1	17	3	25
45-64	8	28	15	52	23	40	10	43	12	52	22	48	4	67	4	67	8	67
Total	29	100	29	100	58	100	23	100	23	100	46	100	6	50	6	50	12	100
c. Parents’ ethnicity? (Q1.3)																		
Caucasian	27	93	28	97	55	95	23	100	21	91	44	96	6	100	4	67	10	83
A. American	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. American	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asian	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	33	2	17
Hispanic	1	3	0	0	1	2	0	0	2	9	2	4	0	0	0	0	0	0
Other	1	3	1	3	2	3	0	0	0	0	0	0	0	0	0	0	0	0
Total	29	100	29	100	58	100	23	100	23	100	46	100	6	100	6	100	12	100
d. Parent’s education? (Q1.4)																		
Not reported	0	0	1	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0
High school or less	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High school or equivalent	0	0	0	0	0	0	1	4	0	0	1	2	0	0	0	0	0	0
Some college	0	0	0	0	0	0	1	4	2	9	3	7	0	0	0	0	0	0
Four-year college/ professional degree	18	62	9	31	27	47	11	48	7	30	18	39	4	67	2	33	6	50
Advanced degree	11	38	19	66	30	52	10	43	14	61	24	52	2	33	4	67	6	50
Total	29	100	29	100	58	100	23	100	23	100	46	100	6	100	6	100	12	100
e. Marital status? (Q1.6)																		
not reported					1	3					0	0					0	0
married/partner					26	90					22	96					5	83

Table 10 (continued)

single	2	7	1	4	1	17
Total	29	100	23	100	6	100

♂= male sign, ♀= female sign, %= percentage, Σ=total, x=average

Table 11: Total physical activities (within and outside the neighborhood)

a. Schooldays and weekends (9 days)																		
	MIX						TRAD						COH					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
N in	14.5	63	8	37	23		15	71	6	29	21		1	25	3	75	4	
Σ in	314	56	251	44	565	91	178	71	74	29	252	59	9	9	93	91	102	87
x in	2.4		3.5		2.7		1.3		1.4		1.3		1.0		3.4		2.8	
N out	14	64	8	36	22		15	71	6	29	21		1	25	3	75	4	
Σ out	19	35	35	65	54	9	122	69	56	31	178	41	3	20	12	80	15	13
x out	0.2		0.5		0.3		0.9		1.0		0.9		0.3		0.4		0.4	
N in & out	14.3	64	8	36	22.3		15	71	6	29	21		1	25	3	75	4	
Σ in & out	333	54	286	46	619		300	70	130	30	430		12	10	105	90	117	
x in & out	2.6		4.0		3.1		2.2		2.4		2.3		1.3		3.9		3.3	

♂= male sign, ♀= female sign, %= percentage, Σ=summation, x=average of PAs/child/day
in=physical activities with the neighborhood, out= physical activities outside the neighborhood

Table 12: Physical activities within the neighborhood

a. Schooldays and weekends (9 days)																		
<i>code</i>	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	14,5		8,0		22,5		15,0		6,0		21,0		1,0		3,0		4,0	
1	308	98	247	98	555	98	177	99	74	100	251	100	9	100	89	96	98	96
<i>1,1</i>	127	41	117	47	244	44	100	56	52	70	152	61	5	56	72	81	77	79
<i>1,2</i>	19	6	11	4	30	5	23	13	9	12	32	13	0	0	4	4	4	4
<i>1,3</i>	158	51	112	45	270	49	38	21	10	14	48	19	2	22	7	8	9	9
<i>1,4</i>	1	0	1	0	2	0	2	1	0	0	2	1	0	0	2	2	1	1
<i>1,5</i>	3	1	6	2	9	2	14	8	3	4	17	7	2	22	4	4	6	6
2	3	1	2	1	5	1	0	0	0	0	0	0	0	0	1	1	1	1
3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2	1	2	1	4	1	1	1	0	0	1	0	0	0	3	3	3	3
Σ	314	56	251	44	565		178	71	74	29	252		9	9	93	91	102	
x	2.4		3.5		2.8		1.3		1.4		1.3		1.0		3.4		2.8	
b. Schooldays (5 days)																		
<i>code</i>	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	15		8		23		15		6		21		1		3		4	
1	155	99	117	97	272	98	92	99	49	100	141	99	5	100	54	98	59	98
<i>1,1</i>	61	39	48	41	109	40	48	52	29	59	77	55	3	60	42	78	45	76
<i>1,2</i>	9	6	3	3	12	4	7	8	9	18	16	11	0	0	2	4	2	3
<i>1,3</i>	81	52	65	56	146	54	30	33	8	16	38	27	1	20	5	9	6	10
<i>1,4</i>	1	1	1	1	2	1	1	1	0	0	1	1	0	0	1	2	1	2
<i>1,5</i>	3	2	0	0	3	1	6	7	3	6	9	6	1	20	4	7	5	8
2	2	1	2	2	4	1	0	0	0	0	0	0	0	0	1	2	1	2
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	2	2	2	1	1	1	0	0	1	1	0	0	0	0	0	0
Σ	157	56	121	44	278	49	93	65	49	35	142	56	5	8	55	92	60	59

Table 12 (continued)

x	2.1		3.0		2.4		1.2		1.6		1.4		1.0		3.7		3.0	
c. Weekends (4 days)																		
code	MIX								TRAD				COH					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
N	14		8		22		15		6		21		1		3		4	
1	153	97	130	100	283	99	85	100	25	100	110	100	4	100	35	92	39	93
1,1	66	43	69	53	135	48	52	61	23	92	75	68	2	50	30	79	32	82
1,2	10	7	8	6	18	6	16	19	0	0	16	15	0	0	2	5	2	5
1,3	77	50	47	36	124	44	8	9	2	8	10	9	1	25	2	5	3	8
1,4	0	0	0	0	0	0	1	1	0	0	1	1	0	0	1	3	1	3
1,5	0	0	6	5	6	2	8	9	0	0	8	7	1	25	0	0	1	3
2	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2	1	0	0	2	1	0	3	8	3	7							
Σ	157	55	130	45	287	51	85	77	25	23	110	44	4	10	38	90	42	41
x	2.8		4.1		3.3		1.4		1.0		1.3		1.0		3.2		2.6	

♂= male sign, ♀= female sign, %= percentage, Σ=summation, x=average of PAs/child/day

Level 1: Lifestyle activities: 1.1 Active play, 1.2 Domestic chores, 1.3 Travel between places, 1.4 Exploration, 1.5 Nature activities

Level 2: Cardiovascular activities (active aerobics): 2.1 Recreation, 2.2 Sports (individual and team)

Level 3: Flexibility and strength exercise

Level 4: Rest and inactivity

Table 13: Physical activities outside the neighborhood

a. Schooldays and weekends (9 days)																		
<i>code</i>	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	14		8		22		15		6		21		1		3		4	
1	10	53	15	43	25	46	84	69	34	61	118	66	3	100	12	100	15	100
1.1	10	100	15	100	25	100	68	81	32	94	100	85	0	0	1	8	1	7
1.2	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0
1.3	0	0	0	0	0	0	7	8	0	0	7	6	3	100	8	67	11	73
1.4	0	0	0	0	0	0	4	5	0	0	4	3	0	0	0	0	0	0
1.5	0	0	0	0	0	0	4	5	2	6	6	5	0	0	3	25	3	20
2	7	37	18	51	25	46	35	29	16	29	51	29	0	0	0	0	0	0
3	2	11	2	6	4	7	0	0	2	4	2	1	0	0	0	0	0	0
4	0	0	0	0	0	0	3	2	4	7	7	4	0	0	0	0	0	0
Σ	19	35	35	65	54		122	69	56	31	178		3	20	12	80	15	
<i>x</i>	0.2		0.5		0.3		0.9		1.0		0.9		0.3		0.4		0.4	

♂= male sign, ♀= female sign, %= percentage, Σ=summation, x=average of PAs/child/day

Level 1: Lifestyle activities: 1.1 Active play, 1.2 Domestic chores, 1.3 Travel between places, 1.4 Exploration, 1.5 Nature activities

Level 2: Cardiovascular activities (active aerobics): 2.1 Recreation, 2.2 Sports (individual and team)

Level 3: Flexibility and strength exercise

Level 4: Rest and inactivity

Table 14: Organized physical activities

a. Organized neighborhood PAs (Q5.17)																		
	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	20		9		29		16		7		23		2		4		6	
Yes	8	40	7	78	15	52	0	0	0	0	0	0	0	0	0	0	0	0

Table 14 (continued)

No	12	60	2	22	14	48	16	100	7	100	23	100	2	100	4	100	6	100
b. Types of organized neighborhood PAs (Q5.17a)																		
	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	20		9		29		16		7		23		2		4		6	
Tennis	3	33	1	10	4	21	0	0	0	0	0	0	0	0	0	0	0	0
Tang soo do	1	11	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0
Swim team	4	44	3	30	7	37	0	0	0	0	0	0	0	0	0	0	0	0
Scouts	1	11	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0
Soccer	0	0	5	50	5	26	0	0	0	0	0	0	0	0	0	0	0	0
Lacrosse	0	0	1	10	1	5	0	0	0	0	0	0	0	0	0	0	0	0
Σ	9	47	10	53	19	100	0	0	0	0	0	0	0	0	0	0	0	0
# types	4		4		6		0		0		0		0		0		0	
<i>x</i>	0.5		1.1		0.7		0.0		0.0		0.0		0.0		0.0		0.0	
c. Organized out-of-neighborhood PAs (Q5.18)																		
	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	20		9		29		16		7		23		2		4		6	
Yes	11	55	6	67	17	59	14	88	7	100	21	91	0	0	2	50	2	33
No	9	45	3	33	12	41	2	13	0	0	2	9	2	100	2	50	4	67
d. Types of organized out-of-neighborhood PAs (Q5.18a)																		
	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	20		9		29		16		7		23		2		4		6	
basketball	1	7	2	25	3	14	4	14	4	22	8	17	0	0	1	50	1	50
fencing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	50	1	50
base/softball	5	36	4	50	9	41	2	7	5	28	7	15	0	0	0	0	0	0
ballet	0	0	0	0	0	0	3	11	0	0	3	7	0	0	0	0	0	0
dance	4	29	0	0	4	18	2	7	0	0	2	4	0	0	0	0	0	0

Table 14 (continued)

soccer	0	0	2	25	2	9	6	21	5	28	11	24	0	0	0	0	0	0
field hockey	0	0	0	0	0	0	2	7	0	0	2	4	0	0	0	0	0	0
riding	2	14	0	0	2	9	1	4	0	0	1	2	0	0	0	0	0	0
tennis	0	0	0	0	0	0	2	7	0	0	2	4	0	0	0	0	0	0
swim team	2	14	0	0	2	9	4	14	4	22	8	17	0	0	0	0	0	0
gymnastics	0	0	0	0	0	0	1	4	0	0	1	2	0	0	0	0	0	0
ice skating	0	0	0	0	0	0	1	4	0	0	1	2	0	0	0	0	0	0
Σ	14	<i>64</i>	8	<i>36</i>	22	<i>31</i>	28	<i>61</i>	18	<i>39</i>	46	<i>66</i>	0	<i>0</i>	2	<i>100</i>	2	<i>3</i>
# types	5		3		6		11		4		11		0		2		2	
x	0.7		0.9		0.8		1.8		2.6		2.0		0.0		0.5		0.3	

♂= male sign, ♀= female sign, %= percentage, Σ =summation, x =average of PAs/day

Table 15: Neighborhood settings

a. Schooldays and weekends (9 days)																		
code	MIX						TRAD						COH					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	15		8		22,5		15		6		21		1		3		4	
1.1	36	38	18	46	52	39	40	43	22	55	62	46	0	0	9	50	9	47
1.2	3	3	11	28	14	10	32	34	11	28	43	32	0	0	2	11	2	11
1.3	12	13	0	0	22	16	8	9	1	3	9	7	0	0	0	0	0	0
1.4	45	47	10	26	55	41	14	15	6	15	20	15	1	100	7	39	8	42
Σ	96	<i>31</i>	39	<i>16</i>	135	<i>24</i>	94	<i>53</i>	40	<i>54</i>	134	<i>53</i>	1	<i>11</i>	18	<i>19</i>	19	<i>19</i>
2.1.1	39	28	9	9	48	20	4	100	0	0	4	100	2	100	32	97	34	97
2.1.2	6	4	6	6	12	5	0	0	0	0	0	0	0	0	1	3	1	3
2.1.3	8	6	20	21	28	12	0	0	0	0	0	0	0	0	0	0	0	0
2.1.4	87	62	62	64	149	63	0	0	0	0	0	0	0	0	0	0	0	0
Σ	140	<i>45</i>	97	<i>39</i>	237	<i>42</i>	4	<i>2</i>	0	<i>0</i>	4	<i>2</i>	2	<i>22</i>	33	<i>35</i>	35	<i>34</i>

Table 15 (continued)

2.2.1	2	9	12	35	14	25	4	6	5	16	9	9	0	0	0	0	0	0
2.2.2	9	39	17	50	26	46	32	48	17	55	49	51	0	0	0	0	0	0
2.2.3	0	0	0	0	0	0	11	17	3	10	14	14	0	0	0	0	0	0
2.2.8	6	26	15	44	21	37	6	9	0	0	6	6	0	0	8	22	8	20
2.2.9	0	0	0	0	0	0	1	2	0	0	1	1	0	0	3	8	3	7
2.2.10	6	26	2	6	8	14	12	18	6	19	18	19	4	100	26	70	30	73
Σ	23	7	34	14	57	10	66	37	31	42	97	38	4	44	37	40	41	40
3.1.1	3	38	3	19	6	25	3	21	0	0	3	18	0	0	3	100	3	60
3.1.2	5	63	13	81	18	75	11	79	3	100	14	82	2	100	0	0	2	40
Σ	8	3	16	6	24	4	14	8	3	4	17	7	2	22	3	3	5	5
4.1	1	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
4.2	39	83	34	79	73	81	0	0	0	0	0	0	0	0	0	0	0	0
4.3	0	0	2	5	2	2	0	0	0	0	0	0	0	0	0	0	0	0
4.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100	2	100
4.7	7	15	7	16	14	16	0	0	0	0	0	0	0	0	0	0	0	0
Σ	47	15	43	17	90	16	0	0	0	0	0	0	0	0	2	2	2	2
Σ	314	56	251	44	565		178	71	74	29	252		9	9	93	91	102	
<i>x</i>	2.3		3.5		2.8		1.3		1.4		1.3		1.0		3.4		2.8	
# types	17		16		18		13		9		13		4		10		11	
<i>x</i> types	1.1		2.0		0.8		0.9		1.5		0.6		4.0		3.3		2.8	
b. Schooldays (5 days)																		
<i>code</i>			<i>MIX</i>					<i>TRAD</i>					<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	15		8		23		15		6		21		1		3		4	
1.1	23	56	6	30	29	48	17	34	14	48	31	39	0	0	4	44	4	40
1.2	1	2	3	15	4	7	15	30	9	31	24	30	0	0	0	0	0	0
1.3	4	10	10	50	14	23	7	14	1	3	8	10	0	0	0	0	0	0
1.4	13	32	1	5	14	23	11	22	5	17	16	20	1	100	5	56	6	60
Σ	41	26	20	17	61	22	50	54	29	59	79	56	1	20	9	16	10	17
2.1.1	24	42	5	11	29	29	0	0	0	0	0	0	0	0	20	95	20	95

Table 15 (continued)

2.1.2	5	9	1	2	6	6	0	0	0	0	0	0	0	0	1	5	1	5
2.1.3	4	7	14	32	18	18	0	0	0	0	0	0	0	0	0	0	0	0
2.1.4	24	42	24	55	48	48	0	0	0	0	0	0	0	0	0	0	0	0
Σ	57	36	44	36	101	36	0	0	0	0	0	0	0	0	21	38	21	35
2.2.1	2	13	6	32	8	24	2	6	5	29	7	15	0	0	0	0	0	0
2.2.2	7	47	5	26	12	35	16	44	8	47	24	52	0	0	0	0	0	0
2.2.3	0	0	0	0	0	0	10	28	2	12	12	26	0	0	0	0	0	0
2.2.8	3	20	8	42	11	32	2	6	0	0	2	4	0	0	3	13	3	12
2.2.9	0	0	0	0	0	0	1	3	0	0	1	2	0	0	3	13	3	12
2.2.10	3	20	0	0	3	9	5	14	2	12	7	15	2	100	17	74	19	76
Σ	15	10	19	16	34	12	36	39	17	35	46	32	2	40	23	42	25	42
2.2.1	2	40	0	0	2	22	2	29	0	0	2	20	0	0	1	100	1	33
2.2.2	3	60	4	100	7	78	5	71	3	100	8	80	2	100	0	0	2	67
Σ	5	3	4	3	9	3	7	8	3	6	10	7	2	40	1	2	3	5
3.2	39	100	33	97	72	99	0	0	0	0	0	0	0	0	0	0	0	0
3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100	1	100
3.7	0	0	1	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Σ	39	25	34	28	73	26	0	0	0	0	0	0	0	0	1	2	1	2
Σ	157	56	121	44	278	49	93	65	49	35	142	56	5	8	55	92	60	59
x	2.1		3.0		2.4		1.2		1.6		1.4		1.0		3.7		3.0	
# types	15		14		16		12		9		12		3		9		10	
x types	1.0		1.8		0.7		0.8		1.5		0.6		3.0		3.0		2.5	
c. Weekends (4 days)																		
<i>Destination code</i>			<i>MIX</i>								<i>TRAD</i>				<i>COH</i>			
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	15		8		22		15		6		21		1		3		4	
1.1	14	25	11	39	25	30	22	51	10	77	32	57	0	0	5	56	5	56
1.2	2	4	8	29	10	12	17	40	2	15	19	34	0	0	2	22	2	22

Table 15 (continued)

1.3	8	14	0	0	8	10	1	2	0	0	1	2	0	0	0	0	0	0
1.4	32	57	9	32	41	49	3	7	1	8	4	7	0	0	2	22	2	22
Σ	56	36	28	22	84	29	43	51	13	48	56	50	0	0	9	24	9	22
2.1.1	15	18	4	7	19	14	4	100	0	0	4	100	2	100	12	100	14	100
2.1.2	1	1	5	9	6	4	0	0	0	0	0	0	0	0	0	0	0	0
2.1.3	4	5	6	11	10	7	0	0	0	0	0	0	0	0	0	0	0	0
2.1.4	62	76	39	72	101	74	0	0	0	0	0	0	0	0	0	0	0	0
Σ	82	52	54	42	136	47	4	5	0	0	4	4	2	50	12	32	14	34
2.2.1	0	0	6	22	6	17	2	7	0	0	2	5	0	0	0	0	0	0
2.2.2	2	25	12	44	14	40	16	53	9	64	25	57	0	0	0	0	0	0
2.2.3	0	0	0	0	0	0	1	3	1	7	2	5	0	0	0	0	0	0
2.2.8	3	38	7	26	10	29	4	13	0	0	4	9	0	0	5	38	5	33
2.2.10	3	38	2	7	5	14	7	23	4	29	11	25	2	100	8	62	10	67
Σ	8	5	27	21	35	12	30	36	14	52	44	40	2	50	13	35	15	37
3.1.1	1	33	3	25	4	27	1	14	0	0	1	14	0	0	2	100	2	100
3.1.2	2	67	9	75	11	73	6	86	0	0	6	86	0	0	0	0	0	0
Σ	3	2	12	9	15	5	7	8	0	0	7	6	0	0	2	5	2	5
4.1	1	13	0	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0
4.2	0	0	1	11	1	6	0	0	0	0	0	0	0	0	0	0	0	0
4.3	0	0	2	22	2	12	0	0	0	0	0	0	0	0	0	0	0	0
4.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100	1	100
4.7	7	88	6	67	13	76	0	0	0	0	0	0	0	0	0	0	0	0
Σ	8	5	9	7	17	6	0	0	0	0	0	0	0	0	1	3	1	2
Σ	157	55	130	45	287	51	84	76	27	24	111	44	4	10	37	90	41	40
x	2.6		4.1		3.3		1.4		1.1		1.3		1.0		3.1		2.6	
# types	15		16		18		12		6		12		2		8		8	
x types	1.0		2.0		0.8		0.8		1.0		0.6		2.0		2.7		2.0	

♂= male sign, ♀= female sign, %= percentage, Σ =summation, x=average number of settings per child

Codes for settings

1 Private settings: 1.1. (child's yard), 1.2 (friend's yard), 1.3 (child's house), 1.4 (friend's house)

Table 15 (continued)

- 2 Formal settings:
 - a. Open space: 2.1.1 (parks, playgrounds etc.), 2.1.2 (school grounds), 2.1.3 (recreation/sports fields), 2.1.4 (swimming pool)
 - b. Streets: 2.2.1 (primary and secondary streets), 2.2.2 (tertiary streets), 2.2.3 (specific street settings), 2.2.5 (train tracks), 2.2.6 (streets good for sledding), 2.2.8 (formal paths), 2.2.9 (other), 2.2.10 (around the neighborhood)
- 3 Informal settings:
 - a. Open space: 3.1.1 (natural areas), 3.1.2 (natural areas w/ water)
 - b. Other: 3.2.1 (storm drain, culvert), 3.2.2 (informal paths), 3.2.3 (other)
- 4 Indoor facilities: 4.1 (sport & rec.), 4.2 (schools), 4.3 (retail & commercial), 4.4 (community centers), 4.7 (movie theater).

Table 16: Non-localized physical activities, linear settings and distance

a. Schooldays and weekends (9 days)																		
	MIX						TRAD						COH					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	15		8		23		15		6		21		1		3		4	
2.2.8	148	94	102	91	250	93	19	50	2	20	21	44	1	50	6	86	7	78
3.2.2	6	4	3	3	9	3	0	0	0	0	0	0	0	0	0	0	0	0
2.2.1	4	3	1	1	5	2	17	45	8	80	25	52	1	50	1	14	2	22
2.2.2	0	0	6	5	6	2	2	5	0	0	2	4	0	0	0	0	0	0
Σ	158	59	112	41	270	83	38	79	10	21	48	15	2	22	7	78	9	3
<i>x</i>	1.2		1.6		1.3		0.3		0.2		0.3		0.2		0.3		0.3	
b. Schooldays (5 days)																		
	MIX						TRAD						COH					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	15		8		23		15		6		21		1		3		4	
2.2.8	78	96	63	97	141	97	15	50	1	13	16	42	0	0	4	80	4	67
3.2.2	2	2	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
2.2.1	1	1	0	0	1	1	13	43	7	88	20	53	1	100	1	20	2	33

Table 16 (continued)

2.2.2	0	0	2	3	2	1	2	7	0	0	2	5	0	0	0	0	0	0
Σ	81	55	65	45	146	77	30	79	8	21	38	20	1	17	5	83	6	3
<i>x</i>	1.1		1.6		1.3		0.4		0.3		0.4		0.2		0.3		0.3	
c. Weekends (4 days)																		
<i>codes</i>	<i>MIX</i>				<i>TRAD</i>				<i>COH</i>									
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	14		8		22		15		6		21		1		3		4	
2.2.8	70	91	39	83	109	88	4	50	1	50	5	50	1	100	2	100	3	100
3.2.2	4	5	3	6	7	6	0	0	0	0	0	0	0	0	0	0	0	0
2.2.1	3	4	1	2	4	3	4	50	1	50	5	50	0	0	0	0	0	0
2.2.2	0	0	4	9	4	3	0	0	0	0	0	0	0	0	0	0	0	0
Σ	77	62	47	38	124	91	8	80	2	20	10	7	1	33	2	67	3	2
<i>x</i>	1.4		1.5		1.4		0.1		0.1		0.1		0.3		0.2		0.2	
d. Distances traveled in the neighborhoods (miles)																		
	<i>MIX</i>				<i>TRAD</i>				<i>COH</i>									
	♀	<i>x</i>	♂	<i>x</i>	Σ	<i>x</i>	♀	<i>x</i>	♂	<i>x</i>	Σ	<i>x</i>	♀	<i>x</i>	♂	<i>x</i>	Σ	<i>x</i>
<i>N</i>	15		8		23		15		6		21		1		3		4	
		<i>miles</i>		<i>miles</i>	<i>miles</i>													
9 days		0,68		1,51	0,97		0,28		0,57		0,36		0,32		0,59		0,52	
schooldays		0,68		1,48	0,96		0,26		0,50		0,33		0,45		0,78		0,70	
weekends		0,67		1,55	0,98		0,30		0,66		0,40		0,16		0,35		0,30	
e. Does your child walk or bike to school? (Q4.2)																		
<i>codes</i>	<i>MIX</i>				<i>TRAD</i>				<i>COH</i>									
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	20		9		29		16		7		22		2		4		6	
Yes					18	62					0	0					4	67
No					2	7					22	100					0	0
Walks and carpools					9	31					0	0					2	33

Table 16 (continued)

f. If yes (including those who walk one way), how far?																		
<i>codes</i>	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
<i>N</i>	20		9		27		16		7		23		2		4		6	
¼ mile or less					12	44					0	0					1	17
¼ - ½ mile					9	33					0	0					4	67
½ - 1 mile					6	22					0	0					1	17
1 mile or more					0	0					0	0					0	0
g. Distance children have traveled to the furthest without an adult																		
<i>Code</i>	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
0-999 ft (1)	2	17	0	0	2	11	2	14	0	0	2	10	1	100	2	100	2	67
1000-1999 ft (2)	3	25	0	0	3	16	5	36	2	33	7	35	0	0	0	0	1	33
2000-2999 ft (3)	3	25	3	43	6	32	4	29	1	17	5	25	0	0	0	0	0	0
3000-3999 ft (4)	2	17	1	14	3	16	3	21	0	0	3	15	0	0	0	0	0	0
4000 ft + (5)	2	17	3	43	5	26	0	0	3	50	3	15	0	0	0	0	0	0
Total	12		7		19		14		6		20		1		2		3	
x	2.9		4.0		3.3		2.6		3.7		2.9		1.0		1.0		1.3	

♂= male sign, ♀= female sign, %= percentage, Σ=summation, x=average # of settings/child/day, 1000ft= 0.19 mile, 2000ft= 0.38 mile, 3000ft= 0.57, 4000ft=0.77 mile

Codes for settings

- 1 Private settings: 1.1. (child’s yard), 1.2 (friend’s yard), 1.3 (child’s house), 1.4 (friend’s house)
- 2 Formal settings:
 - a. Open space: 2.1.1 (parks, playgrounds etc.), 2.1.2 (school grounds), 2.1.3 (recreation/sports fields), 2.1.4 (swimming pool)
 - b. Streets: 2.2.1 (primary and secondary streets), 2.2.2 (tertiary streets), 2.2.3 (specific street settings), 2.2.5 (train tracks), 2.2.6 (streets good for sledding), 2.2.8 (formal paths), 2.2.9 (other), 2.2.10 (around the neighborhood)
- 3 Informal settings:
 - a. Open space: 3.1.1 (natural areas), 3.1.2 (natural areas w/ water)
 - b. Other: 3.2.1 (storm drain, culvert), 3.2.2 (informal paths), 3.2.3 (other)
- 4 Indoor facilities: 4.1 (sport & rec.), 4.2 (schools), 4.3 (retail & commercial), 4.4 (community centers), 4.7 (movie theater).

Table 17: Children’s favorite places

a. Types of favorite places																			
<i>Codes</i>	<i>MIX</i>					<i>TRAD</i>					<i>COH</i>								
	♀	♂	Σ	♀	♂	Σ	♀	♂	Σ	♀	♂	Σ	♀	♂	Σ				
<i>N</i>	13	6	19	14	5	19	0	1	1										
1.1	4	6	1	3	5	5	1	2	1	7	2	3	0	0	0	0	0	0	
1.2	1	1	0	0	1	1	4	8	1	7	5	8	0	0	0	0	0	0	
Σ	5	7	1	3	6	6	5	10	2	13	7	11	0	0	0	0	0	0	
2.1.1	18	27	2	6	20	19	5	10	0	0	5	8	0	0	1	100	1	100	
2.1.1	2	3	2	6	4	4	0	0	0	0	0	0	0	0	0	0	0	0	
2.1.3	3	4	2	6	5	5	0	0	0	0	0	0	0	0	0	0	0	0	
2.1.4	12	18	5	14	17	17	0	0	0	0	0	0	0	0	0	0	0	0	
Σ	35	52	11	31	46	45	5	10	0	0	5	8	0	0	1	100	1	100	
2.2.1	3	4	0	0	3	3	1	2	3	20	4	6	0	0	0	0	0	0	
2.2.2	3	4	4	11	7	7	3	6	3	20	6	10	0	0	0	0	0	0	
2.2.5	0	0	0	0	0	0	3	6	0	0	3	5	0	0	0	0	0	0	
2.2.6	0	0	0	0	0	0	1	2	1	7	2	3	0	0	0	0	0	0	
2.2.8	3	4	2	6	5	5	1	2	1	7	2	3	0	0	0	0	0	0	
2.2.9	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
2.2.10	0	0	0	0	0	0	1	2	0	0	1	2	0	0	0	0	0	0	
Σ	10	15	6	17	16	16	10	21	8	53	18	29	0	0	0	0	0	0	
3.1.1	2	3	3	8	5	5	14	29	2	13	16	25	0	0	0	0	0	0	
3.1.2	8	12	4	11	12	12	12	25	2	13	14	22	0	0	0	0	0	0	
3.2.2	1	1	0	0	1	1	1	2	1	7	2	3	0	0	0	0	0	0	
3.2.3	1	1	3	8	4	4	1	2	0	0	1	2	0	0	0	0	0	0	
Σ	12	18	10	28	22	21	28	58	5	33	33	52	0	0	0	0	0	0	
4.3	0	0	3	8	3	3	0	0	0	0	0	0	0	0	0	0	0	0	
4.7	5	7	5	14	10	10	0	0	0	0	0	0	0	0	0	0	0	0	
Σ	5	7	8	22	13	13	0	0	0	0	0	0	0	0	0	0	0	0	
Σ	67	100	36	100	103	62	48	100	15	100	63	38	0	0	1	100	1	100	
# types	15	12	16	13	9	13	0	1	1										

Table 17 (continued)

x	5.2		6.0		5.4		3.4		3.0		3.3		0		1.0		1.0	
b. Number of favorite places																		
	MIX						TRAD						COH					
#	♀		♂		Σ		♀		♂		Σ		♀		♂		Σ	
N	13		6		19		14		5		19		0		1		1	
0	2	15	2	33	4	21	1	7	1	20	2	11	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100	1	100
2	3	23	0	0	3	16	2	14	1	20	3	16	0	0	0	0	0	0
3	0	0	0	0	0	0	6	43	3	60	9	47	0	0	0	0	0	0
4	3	23	1	17	4	21	4	29	1	20	5	26	0	0	0	0	0	0
5	1	8	1	17	2	11	2	14	0	0	2	11	0	0	0	0	0	0
6	3	23	1	17	4	21	0	0	0	0	0	0	0	0	0	0	0	0
7	1	8	3	50	4	21	0	0	0	0	0	0	0	0	0	0	0	0
8	1	8	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	1	8	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0

♂= male sign, ♀= female sign, %= percentage, Σ=summation, x=average of settings/child/day

Codes for settings

- 1 Private settings: 1.1. (child’s yard), 1.2 (friend’s yard), 1.3 (child’s house), 1.4 (friend’s house)
- 2 Formal settings:
 - a. Open space: 2.1.1 (parks, playgrounds etc.), 2.1.2 (school grounds), 2.1.3 (recreation/sports fields), 2.1.4 (swimming pool)
 - b. Streets: 2.2.1 (primary and secondary streets), 2.2.2 (tertiary streets), 2.2.3 (specific street settings), 2.2.5 (train tracks), 2.2.6 (streets good for sledding), 2.2.8 (formal paths), 2.2.9 (other), 2.2.10 (around the neighborhood)
- 3 Informal settings:
 - a. Open space: 3.1.1 (natural areas), 3.1.2 (natural areas w/ water)
 - b. Other: 3.2.1 (storm drain, culvert), 3.2.2 (informal paths), 3.2.3 (other)
- 4 Indoor facilities: 4.1 (sport & rec.), 4.2 (schools), 4.3 (retail & commercial), 4.4 (community centers), 4.7 (movie theater).

Table 18: Parents' perception of opportunities for children's outdoor activities and neighborhood safety

a. How would you rate your neighborhood in terms of opportunities for children's outdoor activities?																		
<i>code</i>	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
Poor (1)	0	0	0	0	0	0	2	13	0	0	2	9	0	0	0	0	0	0
Fair (2)	3	15	2	22	5	17	12	75	1	14	13	57	0	0	0	0	0	0
Very good (3)	16	80	7	78	23	79	2	13	6	86	8	35	2	100	4	100	6	100
Σ	19		9		28		16		7		23		2		4		6	
b. How safe is your neighborhood in terms of the physical environment?																		
<i>code</i>	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
Not safe (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fairly safe (2)	10	50	2	22	12	41	7	44	1	14	8	35	0	0	1	25	1	17
Very safe (3)	10	50	7	78	17	59	9	56	6	86	15	65	2	100	3	75	5	83
Σ	20		9		29		16		7		23		2		4		6	
x (code)	2.5		2.8		2.6		2.6		2.9		2.7		3.0		2.8		2.8	
c. How safe is your neighborhood in terms of social crime?																		
<i>code</i>	<i>MIX</i>						<i>TRAD</i>						<i>COH</i>					
	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%	♀	%	♂	%	Σ	%
Not safe (1)	2	10	0	0	2	7	0	0	0	0	0	0	0	0	0	0	0	0
Fairly safe (2)	9	45	4	44	13	45	7	44	2	29	9	39	0	0	0	0	0	0
Very safe (3)	9	45	5	56	14	48	9	56	5	71	14	61	2	100	4	100	6	100
Σ	20		9		29		16		7		23		2		4		6	
x (code)	2.4		2.6		2.4		2.6		2.7		2.6		3.0		3.0		3.0	

♂= male sign, ♀= female sign, %= percentage, Σ=summation, x=average code/total