DISSERTATION

HOW THE BUILT ENVIRONMENT INFLUENCES UTILITARIAN PHYSICAL ACTIVITY: A NORMATIVE FOCUS THEORY MODEL

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY WILLIAM J. SZLEMKO ENTITLED, "HOW THE BUILT ENVIRONMENT INFLUENCES UTILITARIAN PHYSICAL ACTIVITY: A NORMATIVE FOCUS THEORY MODEL" BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

HOW THE BUILT ENVIRONMENT INFLUENCES

UTILITARIAN PHYSICAL ACTIVITY: A NORMATIVE FOCUS THEORY MODEL

American rates of obesity and overweight have reached epidemic proportions (American Public Health Organization, 2005). Recently, Utilitarian Physical Activity (UPA) has been proposed as an intervention (Frank, Engelke, & Schmid, 2003). Rather than expecting exercise for the sake of exercise, UPA promotes walking to work or taking the stairs instead of the elevator.

Research into how the built environment influences physical activity has, thus far, been based largely on a trial and error method. Additionally, there is currently no theory or proposed mechanism that explains why different features of the built environment influence physical activity, nor why environments that combine known predictors of physical activity do not always have an impact on physical activity.

A possible explanation is that in addition to incorporating important design features, the environment also provides normative information. Specifically, the structure of the environment provides information about injunctive norms (what people dis/approve of in situations) and descriptive norms (what people do in specific situations). The purpose of the present project was to determine whether changes in the built environment would lead to changes in perceived norms.

Study 1 (n = 871) examined structural equation models from three different university campuses. Results indicated that known features of the built environment contribute substantially to both descriptive and injunctive norms. Both injunctive and descriptive norms were found to form three distinct factors related to UPA on-campus, UPA off-campus, and UPA inside of buildings, and both types of norms mediated the effect of walkability on self-reported UPA.

In Study 2, 382 participants evaluated photographs, some of which had been altered in Photoshop.™ Changes in bikes and bike racks were specifically designed to provide information about injunctive (more vs. fewer bike racks) and descriptive (more vs. fewer bikes in racks) norms. Analyses indicated that high levels of injunctive and descriptive norms resulted in higher perceived use of UPA, but had less impact on self-reported use of UPA.

These two studies provide evidence that the built environment does help create specific norms. This information is an important step in developing a theoretical approach to design of the built environment for influencing UPA.

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CHAPTER ONE

INTRODUCTION

It is well established that American rates of obesity and overweight have reached epidemic proportions. Currently, an estimated 23.1% of all Americans are obese (Body Mass Index (BMI) >30) and 64.5% are classified as overweight (BMI > 25; American Public Health Organization, 2005; Flegal, Carrol, Ogden & Johnson, 2002; Mokdad, Bowman, Ford Vinicor, Marks & Koplan, 2001). Unfortunately, if past research is an indication, the proportion of Americans who are overweight or obese will only continue to increase. In only seven years' time (1991-1998), self-reported obesity among American adults increased by nearly 6% (Mokdad et al., 2001). The National Health and Nutrition survey conducted during 1999-2000 predicts that unless something is done to stop the increasing weight gains, 40% of the American population will be considered obese by the year 2010. Since increased weight gain and a lack of physical activity have extensive consequences for public health, this is becoming an ever more important issue.

Science has known for many years that physical activity has many health benefits, and consequently a very large number of physical activity interventions have been created and employed. Unfortunately, as the numbers above indicate, these interventions are at best slowing the ever increasing weight gain. In recent years some researchers have suggested that the only way to truly make a difference in this effort is for people to change their lifestyles. To this end the built environment has been identified as an important barrier/facilitator of this lifestyle change. While there is considerable evidence that the built environment can have a significant impact on physical activity and consequently weight gain, it is not clear how this occurs. The current state of the research in this area seems to assume that if the environment is changed, then people will suddenly become physically active. The purpose of this paper is to propose and evaluate an explanatory mechanism of how the built environment operates on physical activity levels through social norms, with implications that refinements in changes to the environment would have more impact on physical activity.

Causes of Obesity

At their root overweight and obesity are caused by ingesting more calories than are used during daily activity. While the cause and effect is simple, the equation is much more complex, with many other variables playing roles including genetics, psychosocial factors and even the physical environment. We will examine each of these in closer detail.

Research supports multiple biological factors as being related to obesity; unfortunately, many people still see being overweight as something that is entirely within the individual's conscious control. Genes are estimated to contribute between 50% and 65% of the likelihood of being overweight. Genetic influence arises in many different aspects; for example, it is well documented that metabolic rate is determined by genetics. This explains why two people who are the same weight and have similar activity levels may eat very different amounts of food and nutrients (Staub, 2002). This seems to be determined in part by how the body absorbs nutrients and the effectiveness of bacteria in the digestive tract (Backhed, Manchester, Semenkovich & Gordon, 2007).

Further evidence of the role that genetics plays in weight comes from a large adoption study that took place in Denmark. Researchers analyzed the weight of 3,500 adopted children, their biological parents, and their adopted parents. Researchers found a very strong correlation between the body compositions of the children and their biological parents; no relationship was seen between children and adopted parents, despite greater similarities in lifestyle and eating habits (Meyer & Stunkard, 1994). Additionally, monozygotic twins who are raised apart have a .74 correlation of BMI, compared to only .32 in dizygotic twins which suggests that genes account for about two-thirds of the variation in BMI (Maes, Neale & Eaves, 1997; Plomin, Defries, McClearn & McGuffin, 2001).

Psychosocial factors related to overweight are numerous. One of the most powerful psychosocial factors related to eating comes directly from conditioning. Early in our lives we are conditioned to associate eating with holidays, as a reward for achieving a goal, love, and perhaps many other events as well. Surprisingly little research has been conducted on classical or operant conditioning related to eating behaviors; what little there is appears to be related to development of taste preference or treatment of eating disorders such as anorexia or bulimia. However, we know that animals can be classically conditioned to expect food in response to a certain stimulus; we also know that food can be used as a reinforcer for learning. It is reasonable to extend these findings into the human species. Indeed, many childcare experts currently teach that having children "clean their plate" leads to overeating and weight control issues later in life.

Socioeconomic factors are also related to obesity. There is considerable correlational evidence that being overweight is inversely related to income and education level. It is not known exactly why this association exits; it is thought that lower SES people are less informed about the importance of healthy diet and exercise and cannot afford healthy foods as readily (Straub, 2002). Another possibility is that lower cost foods, which are bought in larger percentages by lower SES individuals, tend to be higher in fat content and lower in nutritional value (Hill, 2004). Environmental factors related to overweight and obesity will be discussed at length later.

Health Costs of Overweight and Obesity and Benefits of Physical Activity

Being overweight or obese poses many health risks; in fact the National Institute of Health (NIH) cites obesity as the second leading behavioral factor related to mortality (Ernsberger & Koletsky, 1999; Miller 1999). The accumulation of body fat contributes to hypertension through crowding of internal space and restriction of blood vessels; in fact individuals who are overweight are three to five times more likely to have hypertension than normal weight people.

Health Consequences of High or Low Physical Activity

There are very few experimental or controlled trials relating health to physical activity or weight; most of the knowledge comes from epidemiological studies. However, the wide agreement between these studies in many nations provides confidence that the conclusions are valid. For example, when researchers examined nearly 6,000 Americans aged 65 or older they found that there were four behavioral factors that were associated with good health, the most important of which was physical activity (Burke, Arnold, & Bild, 2001). It was also found that physical activity was an important protective factor for hypertension, obesity, high cholesterol and smoking among both African-Americans and Caucasians aged 40 and over. Among more than 5,000 Turkish adults, researchers found that physical activity was inversely correlated with obesity, cigarette smoking, alcohol consumption, diabetes and hypertension (Erem, Arslan & Hacihasanoglu, 2004). Similar results have been found among mainland Chinese (Hu, Pekkarinen & Hanninen, 2002; Tian & Wang, 2005), and British citizens (Taylor, Doust & Webborn, 1998).

Researchers have also examined the effect of weight and lack of physical activity on cancer. Anne McTiernan and her colleagues conducted a five-year prospective cohort study with nearly 75,000 American women. They found that physically active women aged 18-50 showed a decreased risk of developing breast cancer of 14 to 18 percent (McTiernan et al., 2003). Additionally, researchers from the University of Minnesota found that in a 15-year study men who were physically active were up to 27% less likely to develop prostate cancer. Swiss researchers have estimated that if all individuals would meet the recommended physical activity guidelines it would prevent approximately 700 cases of colon, breast, endometrial, kidney and esophageal cancer each year (Ceschi, Gutzwiller, Moch, Eichbolzer & Probst-Hensch, 2007).

Each of the above diseases has been linked directly to lack of physical activity and is often comorbid with obesity. Other conditions have been related to obesity and overweight, but have not yet been evaluated with regard to physical activity. Since the association between physical activity and weight is so well established, it is reasonable to assume that physical activity is related to these other conditions as well. In a series of epidemiological studies in Iran researchers examined asthma prevalence and severity among both adults and children. They consistently found that weight was positively correlated with having asthma and asthma severity (Amra, Rahmani, Salimi, Mohammedzadeh & Golshan, 2005; Tavasoli, Heldarnazhad, Kazemnejad & Miri, 2005). Similar results have been found elsewhere (Brisbon, Plumb, Brawler & Paxman, 2005).

Psychological Consequences of High or Low Physical Activity

Physical activity is considered by many researchers to be the single most effective strategy for minimizing stress (Thayer, Newman, & McClain, 1994). At a physiological level physical activity increases hormones that produce anti-depressant or anti-anxiety effects in most people (Sacks, 1990). Engaging in physical activity is believed to buffer stress through suppression of stress reactivity responses. In one classic study researchers presented physically active and inactive people with unsolvable anagram jumbles. After a participant failed to solve the anagrams researchers reported that the participant's performance was "well below average." While both groups showed increased muscle tension, blood pressure and perceived stress, the physically active group showed significantly smaller increases in these measures (Brown, 1991). Indeed, a meta-analysis of studies related to stress reactivity demonstrated that there was a moderate effect of physical activity such that physically active people showed less stress reactivity (Crews & Landers, 1987; Taylor, 2000).

Psychologically, physically active individuals perceive less stress in part because physically active people tend to feel more positive about their physical appearance. Norvell and Belles (1993) assigned law enforcement officers to an exercise group or a control group. After four months those in the exercise group reported significantly less stress and physique anxiety. Among college students who completed a semester-long physical activity course, physique anxiety decreased by 13% for women and 20% for men with most of the change occurring in the later half of the semester (Bowden, Rust, &

Dunsmoore, 2005). Although this study did not measure stress itself, a positive relationship between physique anxiety and perceived stress in social situations has been previously extablished (Finkenberg, DiNucci, McCune, Chennette, & McCoy, 1998; Hart, Leary & Rejeski, 1989).

While stress and anxiety are important, some say they are implicated in up to 80% of lifestyle diseases (Cathy Kennedy, personal communication, October 2006). There are many other mental health issues that are related to a lack of physical activity. In a study of dementia patients, researchers identified physical activity as being a protective factor and found that it can play a major role in preventing dialysis-associated dementia (Rob, Niederstadt & Reusche, 2001). Even for persons who already have Alzheimer's disease, adding physical activity has been shown to slow symptom progression and help maintain cognitive functioning; additionally, research indicates that physical activity during midlife is associated with reduced risk of dementia more than 20 years later (Rolland et al., 2007; Rovio et al., 2005). Similar results have been shown among Japanese and Canadians (Lindsay, Sykes & McDowell, 2004; Yamada, Kasagi & Sasaki, 2003).

Economic Costs of Overweight and Obesity

Given the types of findings presented above it is not surprising that being overweight results in increased health care costs. Being overweight increases health care expenditures by approximately 15% while being obese increases health care expenditures by over 35%; total health care costs associated with being overweight or obese represent approximately 9.1% of the total annual medical expenditures in the United States (Finkelstein, Fiebelkorn, & Wang, 2003). For a Caucasian woman between 35 and 44 years of age who is in otherwise good health, being overweight was found to be associated with a $500 increase in annual health care expenditures per person; being obese was associated with a $700 increase in annual health care expenditures per person (Wee et al., 2005). Since all other comparison groups exhibited even greater increases in annual health care expenditures, it can be concluded that the $500-$700 increase in annual health care spending per person represents a very conservative estimate. Insurance companies are especially interested in tracking the growth of their payouts to clients.

Researchers recently found that the increase in obesity prevalence accounted for 12 percent of the total growth observed in health care expenditures (Thorpe, Florence, Howard, & Joski, 2004). In reaction to this, at least one insurance carrier is advertising (television, internet, magazines) that if a person loses weight and keeps it off for a year the insurer will reduce the individual's premiums. Using data from seven states, researchers found that when accounting for direct medical costs, workers compensation, and lost productivity, being overweight cost over $94 billion dollars (Chenoweth & Leutzinger, 2006). Based on their data the researchers estimated that the national cost of being overweight was $507 billion in 2003 and that this would reach $708 billion by the year 2008. The authors went further with the analysis and found that if persons who were overweight would lose 5 percent of their body weight the national savings would be $31 billion a year. This is especially impressive because a five percent reduction in weight would still not make most individuals fall in the normal weight category—it would simply move them closer to it. Further, an annual saving of $5 billion could be achieved if only 10 percent of the overweight population adopted a walking program (Jones & Eaton, 1994). Certainly walking to work or the grocery store would go a long way in reducing the economic burden of excess weight.

Activity Intervention Success Rates

Physical activity interventions have been evaluated for a considerable length of time. Unfortunately, even with our knowledge of behavioral sciences most interventions only affect a small number of people and with very limited results. In a meta-analysis of interventions researchers examined 57 randomized controlled physical activity interventions that were administered to older adults. The authors concluded that although all interventions produced behavioral change, the changes were quite small, barely above chance, and were short lived with most participants quickly returning to pre-intervention activity levels (van der Bij, Laurant & Wensing, 2002). Among an adult population a meta-analysis of 22 studies found that compared to control groups, only 10% more people in intervention groups increased physical activity levels (Sorensen, Skovgaard & Puggaard, 2006). Among younger populations the results seem even more depressing. Thomas (2006) reports that among 57 randomized controlled trials that were targeted at children and youth, only 4 of the 57 interventions reported statistically or clinically significant differences between the control groups and the intervention groups.

Kahn and colleagues (2002) conducted perhaps the most exhaustive meta-analysis on the topic. They evaluated well over 100 interventions and found that only 6 were effective. Of these six, two were point-of-decision prompts that were geared towards utilitarian physical activity, three were social-behavioral interventions, and one was an environmental policy intervention.

Survey of "Successful" Interventions

With physical activity having so many health and economic benefits it is not surprising that a wide range of interventions have been attempted. Unfortunately, research indicates that of Americans who initiate an exercise or physical activity program over 50 percent will quit within the first six months (Clark, Stump, & Damush, 2003; Fallon, Hausenblas & Nigg, 2005). Due to the extensive variability in intervention methods and theories, a brief summary of some of the better researched and implemented interventions will be described.

In-home exercise interventions are perhaps the most successful of all. In these interventions a trained volunteer visits the home between 2 and 4 times per week to help the individual engage in physical activity and exercise. Typically, these types of interventions have very high adherence rates (74% over 1 year, 100% over four months) and result in other benefits such as improved social functioning (Castro, Wilcox & O'Sullivan, 2002; Etkin, Prohaska & Harris, 2006). Unfortunately, these types of interventions require a significant amount of time that limits how widely they can be utilized.

Researchers have also employed a strategy suggested by the health belief model, where individuals are made aware of their susceptibility to health risks, informed of the benefits of increasing activity, are made aware of their activity levels, and are provided with counseling sessions, either in person or over the phone. In studies of this type it is quite common to have about one-third of participants drop out within three months and up to 50% at six months (Courneya, Friedenreich & Quinney, 2004; Paschali, Goodrick & Kalantzi-Azizi, 2005; Tudor-Locke & Chan, 2006).

So far each of the interventions discussed has had periodic counseling sessions which undoubtedly help keep participants motivated and feeling accountable. Without the expensive and time-consuming counseling session component, dropout rates rise to 66%

to 75% within six months regardless of intervention type or strategy (Griffin-Blake & DeJoy, 2006; Hallam & Petosa, 2004).

Commentary on Adherence and Dropout Rates

It seems that regardless of the type of intervention utilized a relatively high percentage of participants will drop out. Even when providing volunteer participants with a free 1-year gym membership and personal training, adherence rates are surprisingly low (71%). It is interesting to note that very few studies examine effectiveness beyond a few months and even fewer evaluate adherence or effectiveness after the intervention has ceased. Indeed, researchers suggest that a reasonable rate of adherence or maintenance over a longer term is approximately 23% (Marcus, King & Bock, 1998; Thorgersen-Ntoumanis & Ntoumanis, 2006).

Utilitarian Physical Activity: A New Method of Fighting Overweight and Obesity

Many of the interventions discussed above and found in the literature rely quite heavily on making relatively large changes to lifestyle. Nearly all interventions ask participants to spend 20 to 30 minutes 3 to 5 times per week engaged in exercise. Another approach, one that is advocated by James Hill, is a small change approach. Hill contends that small changes in physical activity levels can add up to have a large effect and are easier to start and maintain over a longer time period (Hill, Peters & Jortberg, 2004).

Utilitarian Physical Activity (UPA) has been proposed as an intervention for increasing the amount of regular exercise while subsequently decreasing the obesity rate (Frank, Engelke, & Schmid, 2003). Rather than expecting exercise for the sake of exercise, this view promotes walking to work or taking the stairs instead of the elevator. Frank and colleagues (2003) argue that UPA provides a form of physical activity that overcomes many of the barriers that are traditionally associated with exercise and recreational physical activity. Some researchers suggest that 2 extra minutes of daily stair usage would lead to a loss of 1.2 pounds per year or that 3 miles of walking 5 days or more a week would yield up to 20 pounds lost in a year (Weinberg & Gould, 2003; Zimring, Joseph, Nicoll, & Tsepas, 2005).

Simple interventions capitalizing on UPA have been proposed by several sources. Hill's (2004) intervention involves 2,000 extra steps per day and 100 fewer calories. Zimring, Joseph, Nicoll, and Tsepas (2005) suggest that two more minutes of climbing stairs per day would result in 1.6 pounds per year in weight loss. A recent government advertising campaign focuses on small steps such as parking one space farther away and taking stairs instead of escalators when holiday shopping (U.S. Department of Health and Human Services, 2005). Independent of these programs, research indicates that walking and taking stairs are feasible ways for sedentary individuals to increase physical activity and maintain fitness (Andersen, Blair, Cheskin, & Bartlett, 1997; Blair, Kohl, & Gordon, 1992; Gordon, Kohl, & Blair, 1993).

It should also be acknowledged that while the primary goal of increasing UPA is health related, there are other potential benefits as well. In a paper that is in preparation, Szlemko has found that environmentally conscious college students report engaging in UPA more often than students who are not concerned about the environment.

Built Environment and Health

It is not unreasonable to think that the built environment influences our physical activity levels and consequently our obesity rates. Thousands of years ago civilizations realized that they could build structures to enhance health. This was the basic principle in the Roman creation of sewer systems, or public bath houses. Beginning in the early 1800s public health officials and urban planners have worked together to better the health of the population. Unfortunately, what was recommended and enacted were not always the best choices.

In 1790 physicians in Manchester, England—one of the first major industrialized cities—associated an outbreak of typhus with working conditions in cotton mills and manufacturing plants (Rosen, 1958). Although physicians reasoned that working conditions were to blame they were not able to tell what specific conditions were helping spread the typhus epidemic. Later, in 1837 an American physician living in New York City made similar observations about disease outbreaks, notably small pox and cholera. This physician, Dr. McCready, believed that the cause of disease outbreak was to be found in the poor areas and tenements of the city. Dr. McCready and many other physicians felt that this was confirmation of the ancient theory of miasma (Rosen, 1958). The theory of miasma claimed that "poor atmosphere" caused disease. It was believed that unsanitary environments created noxious gases that caused disease when they were inhaled. As a result of Dr. McCready's efforts, sanitation reform began in earnest and significant progress had been made by the mid-1800s, including construction of sewers, dumps, and the creation of street cleaners.

The next major development in the history of the built environment and health came after the end of the U.S. Civil War. Frederick Olmstead—the creator of New York's Central Park and many other urban parks—served as the secretary of the U.S. Sanitary Commission. In this role he emphasized simply cleaning the streets was not enough. He felt that the noxious gasses espoused by miasma theory would collect in narrow streets and overcrowded areas. Olmstead believed that by creating more open space that allowed air circulation and sunlight, these noxious gasses could be dispersed. He further believed that trees and other plants had a sanitizing effect on their immediate environment and would neutralize any noxious gasses in the area (Fein, 1967; Sutton, 1971). Thus the creation and construction of city parks and land tracks was a direct attempt to improve public health. Olmstead's beliefs and influence also brought about the first zoning and building regulations, which were designed to force builders to allow enough space and sunlight so that residents would not become ill.

In the early 1900's when the theory of miasma was proven false, physicians, planners and others were still concerned with building too close and overcrowding an area. By this time they had realized that although people were made ill by bacteria and other germs, the same conditions that supposedly gave rise to noxious gasses allowed disease to spread more quickly. As a result, planners and health officials continued to emphasize spreading out the population and reducing overcrowding into the later half of the 1900s. As automobiles became more prevalent planners continued with the idea of spreading out the population base but also sought ways of limiting traffic speed. To this end they developed winding road networks that seldom connected to each other (loop and lollipop design). This type of road network reduced traffic and traffic speed while continuing the trend of creating more space between residents, a policy that greatly contributed to the development of urban sprawl. The creation of urban sprawl undoubtedly helped fight the spread of contagious disease; unfortunately as medicine conquered many infectious diseases and extended our lifespan, this same environment began to contribute to lifestyle diseases (Frank, Engleke & Schmid, 2003). Since we have already seen that many physical activity and exercise interventions do not work, it seems reasonable that the solution to the issue should examine the environment that originally contributed to the problem – the built environment.

Built Environment and Utilitarian Physical Activity

Effects of the built environment on physical activity have been addressed most extensively within the public health and city planning fields. These fields have been mostly focused on three factors that are related to walkability, typically defined as how easy and likely it is that an individual will walk within that environment. The three factors that the public health field typically associates with walkability are proximity, connectivity, and land use patterns.

Proximity

Proximity refers to the amount of distance between (A) point of origination and (B) destination (Frank et al., 2003). Distance can be calculated in multiple ways, but the two most common are the “crow-fly” and “network” distance. Crow-fly distance refers to the straight-line distance between points A and B. As a straight line, this is clearly the shortest distance between the points, but it does not allow for physical obstacles that are in the path of the crow-fly distance. A large wall, building, lake, etc. all require the individual to veer from the straight line and go around these environmental features. This leads to what is called the “network” distance, defined as the shortest distance one can travel along the network of streets or paths between points A and B. In nearly all cases the network distance will be greater than the crow fly distance.

The importance of proximity was demonstrated by a United States Department of Transportation study that reported that although Americans make 56 million walking trips daily and 9 million bicycling trips daily, this represents less than 7 percent of all trips taken daily (Federal Highway Administration, 1997). Over 60% of these 56 million walking trips are less than two-thirds of a mile and about 95% are less than two miles. Bicycling trips are also relatively short, with over 95% being less than five miles (Antonakos, 1995). Clearly, based on these data Americans are unwilling to travel very far by either foot or bicycle, demonstrating the importance of proximity.

In a recent study of public park usage, including physical activity, researchers found that the single best predictor of park use was proximity (Giles-Corti et al., 2005). Giles-Corti and colleagues combined data from 1,778 randomly surveyed homes and geographic information system (GIS) data that included proximity. They found that participants with access (close proximity) to parks were 87% more likely to report achieving high levels of walking, when compared to individuals with low access (low proximity) to the same parks. In another recent study 411 college students were asked to provide residence locations and information about their exercise patterns in surrounding areas (both outdoor and indoor). The researchers found that proximity predicted more occasions of exercise per week, longer exercise sessions, and greater intensity of exercise sessions (Reed & Phillips, 2005).

Berke and collegues (2007) recently surveyed 936 senior residents of Seattle (aged 65 to 97) about their walking habits. The study found that parks and walking trails were not a significant predictor of how much seniors engaged in walking. Instead, what determined levels of walking was proximity to locations such as restaurants and grocery stores. Seniors in this study rarely walked beyond one-half mile from their home. Although the walked distances were relatively short, the study found that living in close proximity to destinations increased both the number of walking trips as well as the average length of walking trips. Other predictors of walking behaviors that were found in this study included perceived safety and the length of the city blocks.

In a study that is currently under review 426 college students were surveyed about health habits, including engagement in utilitarian physical activity. Researchers found that college students became less likely to use UPA once distances reached three-quarters of a mile, a figure that is remarkably consistent with earlier studies (Szlemko, Benfield, Bell, Thomas, & Tompkins, in review). This study was also one of the first to consider proximity within a building. Specifically, researchers found that approximately 80% of students were willing to climb 1 or 2 flights of stairs to reach their residence but only 65% were willing to climb 3 or 4 flights of stairs, and less than 30% were willing to climb more than 4 flights of stairs. Thus it appears that proximity can be measured on many levels, but that at each level it is predictive of engaging in UPA.

Each of these studies suggests that for physical activity to take place, proximity is a key ingredient, and further, that the closer the proximity the better. However, this need not be the case. Studies in Europe also indicate that proximity is an important variable, yet in Europe people are willing to engage in physical activity over much larger distances. Studies of European cities consistently report that walking and bicycling account for 20 to 54% of all trips, compared with only 7% in the United States. Additionally, researchers find that the trips in Europe are considerably longer with 11% of all trips (motorized and non-motorized) being bicycle trips that are in excess of 6 miles (Beatley, 2000; Haefeli, 2001; Pucher & Lefevre, 1996). This is quite surprising as bicycle trips that are in excess of 6 miles make up a greater proportion of total trips in Europe than the combination of all walking and bicycling trips in the United States.

Connectivity

Connectivity is a function of the street or path network and as such relates to the options available for getting from originations to destinations (Frank, Engelke & Schmid, 2003). Connectivity can be measured as a function of having a large number of blocks and intersections per unit of space. This can be further refined by examining the number of 3-way intersections compared to the number of 4-way intersections. In this instance a 4-way intersection allows more options for direction of travel than does a 3-way intersection, which indicates greater connectivity. Other network factors that influence connectivity include the number of dead-end streets, cul-de-sacs, and one-way traffic patterns. Grid patterns are high in connectivity, while many residential neighborhoods, with long winding streets that lead to cul-de-sacs, have low connectivity. Increasing connectivity is in effect increasing network proximity. Thus, there is a lot of overlap between these concepts.

Connectivity can also be measured as a function of crow-fly distance divided by network distance, with numbers closer to 1 indicating higher connectivity. Moudon and colleagues (1997) studied 12 neighborhoods that differed on street networks. Six of the neighborhoods were built on a grid pattern and had high connectivity as well as good quality pedestrian facilities (e.g., continuous sidewalks); the other six neighborhoods were constructed with much lower connectivity. All 12 of the neighborhoods had commercial centers where residents could easily do most of their shopping, eating out, movie watching or whatever other activities they might want. After controlling for density, land use mix, and region, connectivity emerged as a significant predictor of walking. A similar finding comes from Nelson and Allen (1997). They found that the amount of network miles was a significant predictor of use.

Moudon's and Nelson's work was purely correlational; however, two studies have examined how changes in networks change activity levels. One of the earliest pre-post studies of connectivity comes from the city of Delft in the Netherlands. As the city was constructing an extensive bicycle network, researchers measured bicycle and vehicle use in two parts of the city. Both parts were measured at two different times. One location served as a control and had no construction or change in bicycle network; the other location did have substantial changes made, including new bicycle paths and bicycle-only bridges and tunnels. In the control location bicycle use was unchanged, although vehicle use increased by 10 percent. In the test location, use of bicycles increased by about 7 percent, which corresponded with an equal drop in vehicle use (Hartman, 1993). Similarly, a city in Germany increased bicycle networks (paths, route signs, and safety campaigns) while also developing numerous traffic calming schemes. The result of this combined effort was that in a five-year period bicycle trips increased by 13 percent while driving did not increase, despite many more citizens owning cars (Hülsmann, 1993).

More recently, Pucher and Dijkstra (2000) examined walking and bicycling trips in cities in the Netherlands and Germany. Specifically, they examined cities that were introducing new bicycle or pedestrian-specific networks. Using a combination of surveys and observational data they found that introducing a network for bicyclists resulted in significant gains in the number of bicycle trips for recreation, commuting and day-to-day tasks (Pucher & Dijkstra, 2000).

Although the previous studies all suggest that increasing connectivity results in increased physical activity levels, some researchers argue that this is not necessarily the case, the most vocal of whom is Randall Crane. Crane argues that the decision to use UPA or a vehicle is essentially a micro-scale cost-benefit analysis. He claims that if connectivity is increased but there are no changes in the cost of using a vehicle or the benefit of using UPA, then people are most likely to use whatever their social climate dictates (Crane, 1999). Certainly this is a valid point and designers should be wary to keep vehicle networks and UPA (bicycle and walking) networks separated.

Land Use Pattern

Land use pattern refers to the arrangement of structures within the built environment, and as such influences the amount of distance between origination and destination (Frank, Engelke & Schmid, 2003). Land use patterns are defined by two components: density and land use mix. Density refers very simply to the number of buildings per unit of area and is therefore more closely related to social density (holding area constant and changing group size). Obviously, density influences proximity to some extent. Low density will lead to decreased proximity. Imagine a small town where everyone lives on several acres of land. This town could have great connectivity, but because of the low density it is a long distance between houses. A denser neighborhood has shorter distances, but still may not necessarily increase overall walkability. Holtzclaw (1994) examined the effect of density on vehicle miles driven on an annual basis. Selecting households from 28 neighborhoods in four different cities, Holtzclaw evaluated how density and land use mix affected the amount of vehicle miles driven by each family. While not necessarily a one-to-one relationship with walking, more driving trips generally means fewer walking trips and vice versa. In this study it was found that doubling residential density reduced vehicle miles by more than 25 percent.

Obviously, doubling of density can become problematic, as many Americans have a preference for having plenty of space around them. Additionally, increasing density may increase feelings of crowding, which have health consequences. Clearly, this is something we would want to avoid since shortsighted health concerns were largely responsible for the development of urban areas that are low in walkability. Social density especially seems to have a negative effect on emotional states (Evans, 1979; Saegert, MacIntosh & West, 1975). In addition to mood effects, crowding has been shown to be related to high blood pressure (D'Atri, Fitzgerald, Kasl & Osterfeld, 1981; Evans, Lepore, Shejwal & Palsane, 1998), increased levels of cortisol and stress (Baum & Paulus, 1987; Evans, 2001), visits to the doctor (Baron, Mandel, Adams & Griffen, 1976), aggression (Regoeczi, 2003), and decision making (Shanteau & Dino, 1993). Building upwards would seem to eliminate some of the sense of crowding, yet even this has been shown to be associated with increased rates of mental illness (Evans, Wells & Moch, 2003; Fanning, 1967).

I would venture that it is possible to effectively increase density without affecting perceptions of crowding. Through use of restorative environments such as rooftop gardens, window boxes, and the judicious use of constructed illusions based on context effects, the perception of space can be created. For example, outside a window a person might plant small trees for a restorative effect; these would not only help visually obscure other buildings, but would generate the illusion of distance due to the differences in relative size between the trees and other buildings.

These types of considerations may become especially important as it appears that increasing density is non-linear. Specifically, Dunphy and Fisher (1994) found that increasing density had little effect on vehicle and UPA behaviors until very high levels of density were reached. Similarly, researchers examining Seattle-area neighborhoods found that a certain threshold of density was needed before any change in transit behavior was observed (Frank, & Pivo, 1995). They found that once a threshold of 13 residents per acre was reached walking behaviors began to rise much more rapidly than driving behaviors. The optimal level of density has remained elusive, and many individuals in urban planning areas are unaware of findings mentioned above that relate density to other health problems.

Land use mix refers to types of buildings within an area, be they residential, business, entertainment, or others. Today it is fairly common to see single-use lands—areas that are devoted entirely to residential homes or to businesses. Having only a single use per zoning area also decreases proximity. Instead, an area with a high land use mix will have residences next to, or even above, businesses, theatres and so on. This pattern means that the individual has closer proximity to markets, restaurants, and other commercial outlets. Cervero (1988) measured travel patterns and physical features in 57 large suburban office complexes. He was specifically trying to determine the role of mixed-use center development on travel behavior. He found that greater land use mix was associated with ridesharing as well as being significantly and positively related to both walking and bicycling trips.

More recently, Cervero and Kockelman (1997) used nearly 2,000 travel diaries, surveys, census information, and GIS to evaluate the role of both density and land use mix on walking and bicycling trips in 50 neighborhoods in the San Francisco Bay area. Their results suggest more levels of complexity than had been thought. For personal trips density was the strongest predictor of UPA. Conversely, for work trips land use mix was the strongest predictor. The authors speculate that this may be due to the high cost of extremely limited parking in the business areas. They suggest that for personal trips the decision to use UPA or a vehicle is based on density and proximity. However, the cost of parking and the difficulty in finding a parking spot become additional costs when considering the use of UPA or a vehicle for work-related travel. If this is the case it would seem to provide some support for Crane's arguments for the necessity of increasing the costs related to vehicle travel.

Cervero and Duncan (2003) moved beyond simple analyses involving only a couple of environmental factors. In this study they gathered data from over 15,000 households in the San Francisco Bay area and included a number of variables that had not been considered previously. Even after controlling for variables such as climate, aesthetics and terrain/elevation change, land use mix was a significant predictor of walking and bicycling for both social and work-related trips.

As with density, land use mix is a double-edged sword. Increased land use mix can also create closer proximity to fast food restaurants, thus promoting an obesogenic environment. It has been documented and confirmed that zoning regulations are an effective means of reducing, at a neighborhood level, the burden and negative effects that are associated with retail alcohol outlets (Ashe, Jernigan, Kline & Galaz, 2003). Ashe and colleagues have explained that zoning regulations for the sale of alcohol work by limiting the number of sale outlets in an area. International research has shown that increases in physical availability of alcohol (especially proximity and density) are causally linked with increases in alcohol consumption (Gruenwald, Ponicki & Holder, 1993). The authors suggest that with the rise of obesity, similar steps should be taken in regards to fast food restaurants. While Ashe made recommendations based on extending knowledge about alcohol, tobacco and firearms sales to the sale of fast food, there were at the time no data to suggest that location of restaurants was having any effect on obesity levels.

One of the first suggestions of how fast food restaurant location was impacting health was conducted by Hill and Peters in 1998. The authors mention that one of the contributing factors is the readily available inexpensive food that is in close proximity to virtually every neighborhood in America. Even this landmark paper did not include any empirical evidence to support their claim. Carter and Swinburn (2004) demonstrated that an obesogenic environment existed in schools in New Zealand and that this environment was related to poor nutrition among students. Perhaps because of the apparent acceptance that proximity to a fast food retailer contributes to the obesity issue, very little empirical evidence has been examined. In fact, to date only one study has sought empirical evidence related to land use mix and fast food availability. Using GIS coded data related to schools and fast food restaurants in Chicago, researchers found that fast food restaurants are clustered around schools up to four times more frequently than would be expected (Austin et al., 2005). Although the authors did not include any health related data, they were able to show that fast food restaurants in closer proximity to schools served more school age kids than did restaurants farther away.

The interaction between proximity, connectivity and land use pattern is very complex, in part because a change to any one of these dimensions also produces a change in the others. Despite the complexity, however, some guiding principles can be established. People prefer simpler and more direct routes to where they are going. This is easily observed on any college campus where paths have been worn in the grass even though there are nearby sidewalks. Clearly, this indicates the importance of proximity and connectivity. Even given close proximity and connectivity, barriers can alter our behavior choices. Szlemko and colleagues (in review) found that individuals living off campus were less likely to walk or bicycle than students living on campus, even when proximity remained the same. One possible explanation for this finding is that students who lived off campus perceived crossing the street as a barrier and so made a different behavior choice. Crane and many other urban planners have stated that it is virtually impossible to predict the behavioral outcomes of a building project before it is finished (Crane, 1999).

Perceived Safety

Although the constructs discussed above have received the most attention from people researching the effects of the built environment on health, there are some other features that are also considered. Unfortunately, many of these elements have been given very rudimentary treatment by health researchers and urban planners. For example, it has only been within the past couple of years that researchers in these fields have considered the impact of safety on UPA, and there has been even less attention concerning how the environment influences perceptions of safety. One of these considerations that urban planners have recently become aware of is perceived safety, particularly safety from traffic. Indeed, perceived safety has been known as a barrier to outdoor physical activity for some time (e.g., Chinn et al., 1999).

Safety can be divided into two components—one related to safety from crime, and one related to safety from traffic accidents, falls, and other injuries that can be called environmental safety. Each of these components may have specific environmental features related to it. We will begin by examining fear of crime. Within neighborhoods Wilcox and colleagues (2003) found that macro-level environmental features were unrelated to fear of crime, suggesting that features typically considered by architects and urban planners have little effect on perceived likelihood of crime. However, crime does discourage people from engaging in activity outside. As early as the 1980s researchers were aware that fear of crime in a neighborhood created behavioral restrictions wherein residents ventured outside less often (Lavrakas, 1982). Other researchers expanded on this finding and asked whether residents would be more likely to engage in activities in their neighborhoods if we could make the neighborhood feel safer. Keane (1998) conducted just this study and found that all residents, but especially women, would be more likely to walk in their neighborhood if it felt safer. While examining the outdoor play behaviors of 177 seventh grade children in an inner city, Gomez and colleagues (2004) found that fear of crime was the primary deterrent for females but not for males.

Fisher and Nasar (1992) examined college campuses to identify areas where students may not feel safe. In their study it was found that students felt least safe in areas that offered refuge for potential offenders, and low prospect (being able to see the surrounding area clearly) and escape for victims. Refuge may take the form of vegetation such as a densely wooded area, or as features of buildings, such as nooks that offer concealment or escape. Low prospect was also related to these same features.

Safety from pedestrian vehicle traffic accidents was found to be related to physical activity in a study by Atkinson, Sallis, Saelens, Cain and Black (2005). Atkinson et al. examined various neighborhood factors as well as self-reported fear of crime and environmental safety; physical activity levels were both self reported and objectively measured with accelerometers. In this study fear from traffic was more strongly related to physical activity levels than was fear of crime.

Another aspect of environmental safety that is of particular importance to older adults is related to fear of falling. Falling risks a particularly debilitating injury for older adults, and numerous researchers have found this to be a significant barrier to activity in this population. Fear of falling is related to both weather conditions and poor sidewalk quality (Jones, & Nies, 1996; Juarbe, Turok, & Pérez-Stable, 2002). Shroyer (1994) listed the most common architectural features that are mentioned as contributing to falls; these included lighting, furnishings and surfaces. For example, some types of surfaces may be slicker when wet than others, which could lead to increased falls and injuries. Both of these types of safety may be assessed, at least partially, through micro-level environmental features. Although fear of falling has not been studied among college students, a pilot study reveals that only one of 354 students enrolled in a general psychology class listed fear of falling as a reason for avoiding outdoor physical activity. Yet, when asked how likely they would be to engage in walking outdoors in conditions that were safe or in conditions that promote falling, these same students showed a large decrease in likelihood of walking under conditions that promote falling (74% vs. 52%).

How the Built Environment Influences Utilitarian Physical Activity

Currently there is no theory or proposed mechanism that explains why different features of the built environment influence physical activity, nor why environments that combine known predictors of UPA do not always have a major impact on UPA. The majority of researchers are still attempting to piece out which features of the built environment have bigger impacts on physical activity. The modal method of investigation is just to measure as many things as the researcher can think of and enter them all into regression or multi-level models. Typically there is no theory employed; rather, the choices are made by what previous researchers have found. A similar approach is taken in the few existing projects where neighborhoods are being built with these concepts in mind. Builders collaborate with planners and include certain features and characteristics (proximity, connectivity, land use mix, safety) that have been found to relate to increased levels of physical activity. While this approach has yielded a considerable amount of data, a theoretical approach that includes psychological mediators would speed the process and serve as a guide for future remodeling and retrofitting of neighborhoods.

A possible explanation for mixed results is that in addition to incorporating the important design features described above, the environment also provides normative information. Specifically, the structure of the environment provides information about injunctive norms (what people dis/approve of in a certain situation) and descriptive norms (what people do in a specific situation). Imagine that as you arrive on a college campus you see lots of bike racks. The presence of bike racks and perhaps dedicated bike lanes implies that commuting by bicycle is something that is approved of and accepted within this community–an injuctive norm. Further, imagine that the same bike racks have numerous bicycles locked to them. Even though you did not see people actually riding their bikes, you can infer that they did. You can also infer that many people actually engage in commuting by bicycle (descriptive norm) and that because there are lots of bike racks available, bicycle commuting is an accepted activity (injunctive norm).

Descriptive Norms

When faced with a decision, descriptive norms–information about what most people do in a situation–can help us to reach an appropriate decision. Descriptive norms have been found to influence behavior in a wide variety of settings. In classic studies on the bystander effect researchers placed students in a room either alone or with a group as they answered a questionnaire; as students worked, the researchers pumped smoke into the room from a wall vent. Students who worked alone often glanced around the room and consequently noticed the smoke quickly; because no-one else was in the room there was no available descriptive norm. Very quickly after noticing the smoke students got up and left to report the incident. Students working in groups tended to be more focused and maintained their concentration on their work. However, when these students noticed smoke they would look at the other individuals in the room to see what their reaction was. Typically, when any given student looked for the reaction of the other students, the other students would be working, thus providing a descriptive norm of staying and not reporting the incident. After noticing the smoke coming into the room, students who were in the group condition took about four times as long to report the smoke as students who worked alone (Darley & Latané, 1968). This study clearly indicates that descriptive norms can have a very profound effect on behavior.

Researchers have examined the role of descriptive norms in a wide range of behaviors and have found that in addition to explaining helping behaviors, they influence binge drinking on campus, cheating on spouses, cheating on taxes and many other behaviors (Buunk & Baker, 1995; Prentice & Miller, 1993; Steenbergen, McGraw & Scholtz, 1992). Additionally, many studies have examined the role of descriptive norms in exercise and physical activity. Researchers have consistently found that descriptive norms are a significant predictor of exercise behavior in multiple populations (Chatzisarantis, & Hagger,2005; Courneya, Conner, & Rhodes, 2006; Okun, Karoly & Lutz, 2002; Okun, Ruehlman & Karoly, 2003; Schlapman, 1995). Although descriptive norms have been clearly associated with behavior, their relationship to the environment is less clear.

Perhaps the best support for the position that the environment itself can provide information about descriptive norms comes from a study that examined littering behaviors. Cialdini and colleagues (1990) conducted a field experiment in a hospital parking lot; as participants exited an elevator into the parking lot they encountered a confederate who was walking towards them while apparently reading a flyer. Half of the time the confederate discarded the flyer into the surrounding environment (littered) and the other half of the time the confederate simply walked past. There was another existing condition, however, a condition that supplied a descriptive norm: for some of the people the parking garage floor was clean and there was no litter, while for others the parking garage floor was littered with flyers, cigarette butts, candy wrappers and other items. When participants arrived at their cars they found that a flyer had been placed on the windshield. The participants now had a choice to make—whether to litter or not.

Evidence of the power of the descriptive norm can be seen by examining the differences in the percent of people who littered even when the confederate did not litter. In the high descriptive norm condition—litter on the floor—32% of the participants discarded their flyer onto the floor. However, in the low descriptive norm condition—no litter on the floor—only 14% of participants threw their flyer onto the floor. In this experiment it can be clearly shown that the state of the environment can provide powerful information about descriptive norms.

If something as simple as litter can have such a profound impact on descriptive norms, imagine what level of behavior change might be possible with intentional planning. Bike racks provide information about local descriptive norms. Imagine that if there are many full bike racks outside of a building this implies that most, or at least a lot, of people ride their bikes. Conversely, if there is only a single bike rack with a single bike outside of the building it implies that most people do not ride bikes. Each of these situations describes a different behavioral norm. The same logic applies to walking paths, bike lanes on roads, street signs that remind drivers about pedestrian rights of way, and other features. It is easy to imagine that if a person looks out the window and sees cars on a road with no sidewalk, he or she might assume that most people drive and few people use utilitarian physical activity; however, if he or she sees a busy bicycle path instead, that provides information about a different descriptive norm.

Injunctive Norms

While descriptive norms tell us what most people do in a situation, injunctive norms tell us what we should do (prescriptive) or not do (proscriptive) in a situation. In a sense, injunctive norms are a society's unwritten codes of conduct. In one of the classic studies on injunctive norms, researchers sought to reduce the theft of petrified wood from Arizona's Petrified Forest National Park. Estimates of wood theft indicate that over a ton of petrified wood is removed by visitors each month. Park officials attempted to reduce theft by use of a sign that stated how much theft was occurring each year, a sign that focused on the descriptive norm. The researchers created other signs that invoked the injunctive norm of not stealing petrified wood. To measure the effectiveness of the signs researchers first removed all petrified wood from various pathways, then "salted" the pathways so that they would know exactly how much wood was there and where it was. At the conclusion of the study the injunctive norm sign had reduced theft from 7.9% to 1.7% (Cialdini, 2003). From this study it can be seen that invoking an injunctive norm can be a powerful tool to get people to perform specific behaviors. Placement of signs can be seen as an addition to the environment, and indeed studies that have used simple signs to increase utilitarian physical activity have had favorable outcomes, possibly because of invoking injunctive norms related to physical activity (Andersen et al., 1998; Webb & Eves, 2005).

Focus Theory of Normative Conduct

There is far more to norms than simply using descriptive and injunctive norms. How they are used and whether they are both giving the same message is equally important, known as the focus theory of normative conduct (Cialdini, Reno & Kallgren, 1990). In an analysis of the famous Iron Eyes Cody anti-littering campaign produced by the Keep America Beautiful organization, Robert Cialdini demonstrated that the descriptive and injunctive norms were not in agreement. Rather, the descriptive norm was that most people litter, while the injunctive norm invoked was that littering is wrong. As part of the field experiment on littering mentioned above, the researchers demonstrated that when the injunctive and descriptive norms were not congruent, more littering took place than when both norms were providing the same message (Cialdini et al., 1990). Research has also indicated that making the norm salient makes behavior more likely (Kallgren, Reno & Cialdini, 2000).

If we apply this same perspective to elements of the built environment, then we can see that we should observe a gradation of utilitarian physical activity depending on how the two norms are aligned. Using bike racks as an example, it could be argued that the presence of a single empty bike rack invokes an injunctive norm towards physical activity. However, if the bike rack is empty then the descriptive norm is that nobody is riding bikes. If however, there were bikes in the rack then the descriptive and injunctive norms are both towards physical activity. Based on the focus theory of normative conduct we would expect to see that a situation with no bike rack and no bikes produces the least amount of UPA, an empty bike rack slightly more UPA, a bike rack with some bikes more yet, and finally a full bike rack the most UPA. Clearly, we can apply the same type of analysis to roadways, roadways with bike paths, only bike paths, and occupied and empty versions of each.

The current studies examined how UPA could be predicted from proximity, connectivity, land use mix, safety, and injunctive and descriptive norms. A proposed model is shown in Figure 1 in which it is suggested that proximity, connectivity, land use mix, and safety predict walkability, and that perceived norms mediate the relationship between walkability and UPA. In Study 1, measures of these predictors, mediators, and

UPA were collected via an internet survey from college students at multiple campuses across the U.S. Specific hypotheses included:

1) The effect of the physical environment on UPA behaviors would be fully mediated by perceived descriptive and injunctive norms. Full mediation was expected because research consistently finds small effect sizes of environmental features on UPA.

2) The effect of peer behavior on UPA behaviors would be partially mediated by descriptive norms, because peer behavior also provides information regarding what is done by the larger community.

3) The effect of perceived safety on UPA behaviors would be mediated through perceived walkability and injunctive norms.

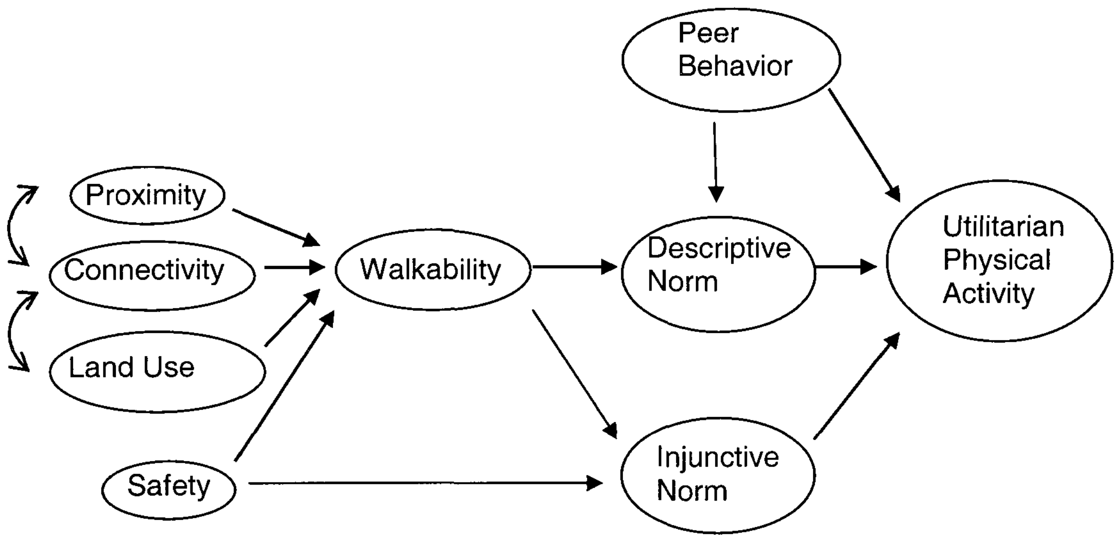


Figure 1. Proposed model of predictors and mediators of UPA.

In Study 2, descriptive and injunctive norms and environmental features were systematically manipulated in photographs of campus scenes that college students evaluated for perceived safety, perceived injunctive and descriptive norms, and the likelihood of using UPA. Hypotheses included:

1) In terms of perceived percent use the conditions would rank order as follows: 1) high injunctive, high descriptive, 2) low injunctive, high descriptive, 3) high injunctive, low descriptive, and 4) low injunctive, low descriptive.
2) Participants would indicate more likelihood of using UPA themselves when both injunctive and descriptive norms were high than when they were both low.

CHAPTER TWO

STUDY 1

Method

Participants

Participants were 871 students living on campuses who were enrolled in psychology classes on different college campuses in the U.S. (369 males and 502 females, mean age = 20.15, *SD* = 4.09). Participants were from a total of seven schools: 285 were from Colorado State University, 181 were from Utah State University, 192 were from University of Colorado Boulder, and the remaining 213 participants were from Mesa State College, University of Nebraska Kearny, Texas A & M Corpus Christi, and Southern Utah University. The vast majority of participants were within the prescribed normal Body Mass Index (BMI) range (*M* = 22.81; *SD* = 1.21), although only 34% of participants reported meeting the recommended daily or weekly physical activity levels. Participants were nearly evenly split with 50.1% living on-campus, and 49.9% living off-campus. Participants were predominantly Caucasian (73%), with African American (3%), Hispanic/Latino (10%), Asian American (3%), Native American/Alaska Native (3%) and others (8%) being represented. All participants completed the study as part of a course requirement or received extra credit for participation.

Materials

Participants completed a modified version of the Minnesota Twin City Walking Survey (MTCWS). The MTCWS consists of 26 assessments and required approximately

45 minutes to complete. For the present study only five sections were used. Each of these sections directly assessed participant perceptions of the environment or perceptions related to safety. Sections assessing the environment included measures of perceived proximity, connectivity and land use mix. The combination of these three factors plus perceived safety ratings formed the latent variable of perceived walkability. For a full list of items see Appendix A. All items used were answered in a 6-point Likert format.

Participants' perceptions of descriptive norms were assessed using a series of items that asked about the perceived use of UPA among other males and females living on campus, other males/females with the same major, other males/females in the same residence hall, students living off campus, and non-student males/females of the community (Appendix B). For each population group participants were asked what percent of the group they believed engaged in UPA (e.g., "What percent of men who live in your residence hall regularly walk to class?"), and how much they agreed or disagreed, on a 6-point Likert scale, with statements of UPA (e.g., "Most men who live in my residence hall usually walk to class.").

Participant perceptions of injunctive norms were assessed with items similar to those used to measure descriptive norms (Appendix C). Items differed in that participants were asked how much they thought that others in each population group believed that people should engage in UPA (e.g., "Most men who live in my residence hall believe that people should walk to class instead of driving.").

Participant UPA was assessed by a series of items that asked about stair and elevator use, number of flights traversed, commute mode to work, commute mode to school, distance of commute, time required to commute, time of day commute took place, number of times a day participant did any walking (between buildings, within a building, on the same floor, etc.) and estimated daily time spent in walking or bicycling for utilitarian purposes (Appendix D). To help assess the accuracy of self-reported distances and times, participants were asked to name the three buildings they visited most often on campus. Distances between all these buildings were calculated and all analyses were based on actual distances. Peer utilitarian physical activity was assessed using a series of items that asked about the amount of UPA engaged in by roommate, best friend, and next three closest friends (Appendix E).

Demographics included age, sex, ethnicity, major, self-reported height, self-reported weight, location of residence, and floor of residence (basement to 12th). Daily weather variables, including temperature, precipitation, humidity, air quality and cloud cover, were also recorded to be used as control variables.

Procedure

An e-mail was sent out to colleagues at various college campuses in the U.S. Within the e-mail was a recruitment message and secure link to an internet site that contained all of the survey materials. Colleagues were asked to encourage their students to complete the survey. In return for their help each university was provided with the data that were relevant to its campus. When students logged on to the secure website, they were presented with a written informed consent. After completion of the informed consent, participants completed the survey, which required about 45 minutes. Finally, participants were presented with a debriefing statement and were allowed to enter their name and school information.

Analysis

Analysis was conducted using structural equation modeling (SEM), which is a method that allows a confirmatory or hypothesis testing approach with multivariate data. There are two important aspects of SEM. First, the processes being investigated are represented by a series of regression equations, and second, these relationships are modeled graphically (Bentler, 1989). This means that the entire system of variables and relationships can be simultaneously evaluated for how well it fits the data. Another aspect that makes SEM desirable as an analysis strategy is that it allows for explicit estimation and correction of measurement error (Byrne, 1994). Using SEM, variables related to walkability, safety, and norms were used to predict the participant's own level of utilitarian physical activity.

Results

Since the Minnesota Twin City Walking Survey has no published reliabilities or factor loadings the first phase of analysis was to examine these "established" scales for measuring proximity, connectivity, land use pattern, safety from traffic, and safety from crime. Each of these scales performed better than expected and had initial alphas ranging from .56-.78. Based on factor analysis, item analysis and evaluation of item content, each of these scales was refined and had ending alphas ranging from .72 - .90 (see Table 1). Appendix A shows the items in the final scales.

Factor analysis of perceived descriptive norm items revealed three distinct norms (see Figure 2). Based on question content it appeared that there were separate norms for UPA performed on-campus (e.g., going to class), UPA performed off-campus (e.g., going to the store), and UPA performed inside of buildings (e.g., taking the stairs). Although

Table 1

Factor Loadings and Cronbach's alphas for Initial and Final Scales from the Minnesota Twin City Walking Survey

	Land Use		Safety from Crime		Proximity		Connectivity		Safety from Traffic	
	Init.	Fin.	Init.	Fin.	Init.	Fin.	Init.	Fin.	Init.	Fin.
Alpha	.66	.78	.56	.90	.78	.81	.63	.72	.64	.75
Item 1	.14	.93	.05		.65		.01		.15	
Item 2	.14	.82	.03		.78	.73	.52	.52	.13	
Item 3	.23	.24	.11		.77		.57	.59	.04	
Item 4	.96		.91	.91	.81	.74	.59	.58	.21	.32
Item 5	.84		.86	.86	.25		.60	.59	.06	
Item 6			.86	.86	.70	.79	.29		.78	
Item 7					.43	.52	.66	.67	.94	
Item 8					.12		.24		.32	
Item 9									.25	.79
Item 10									.25	.90
Item 11									.47	.68
Item 12									.16	

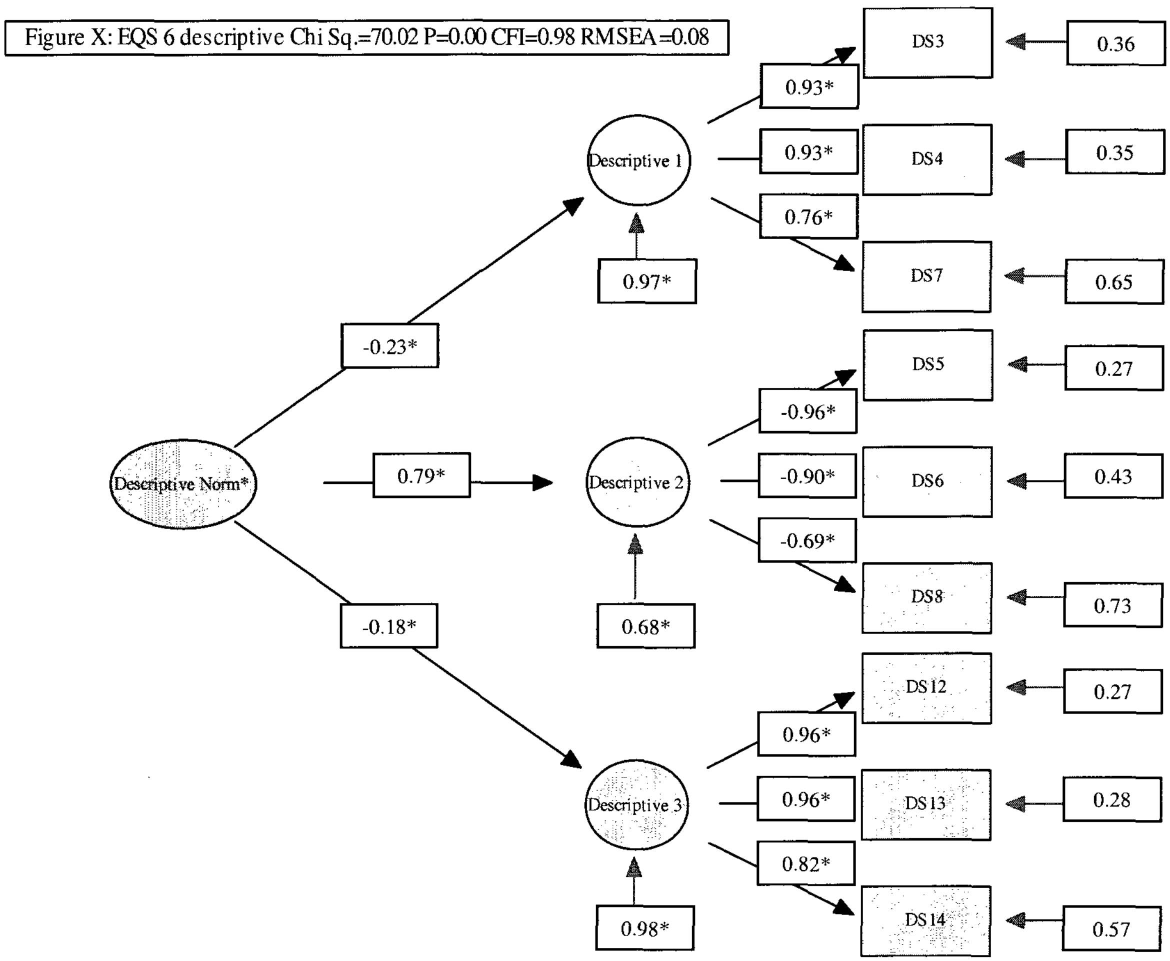


Figure 2. Factor structure of descriptive norms.

each of these contributed substantially to a secondary factor, there was little covariance between each (see Figure 3). Although evidence for three distinct descriptive norms was found, data related to walkability constructs (proximity, connectivity, land use pattern) were not available for UPA inside of a building, and UPA data were not collected for UPA performed off-campus; thus, all further analyses focused on the descriptive norm related to on-campus UPA that was not inside of a building. This suggests that what is commonly performed varies as a function of location.

Analysis of perceived injunctive norm items revealed a similar trend and also exhibited three distinct injunctive norms (see Figure 4) that corresponded with those mentioned earlier (on-campus, off-campus, inside of buildings). Each of the injunctive norms exhibited considerable covariance with others, (see Figure 5) suggesting that although what is done varies as a function of location, what is valued or approved of remains relatively stable across locations. As with descriptive norms, absence of meaningful data on dimensions of walkability and actual UPA off-campus and inside buildings required that all further analyses be limited to the injunctive norm for on-campus UPA.

Hypothesis 1 held that the effect of the built environment would be fully mediated by descriptive and injunctive norms. Figure 6 shows initial models for each campus which include only elements of the built environment and a direct path to utilitarian physical activity. On each campus the construct of walkability had a small but statistically significant effect on self-report UPA levels. Exploratory model building was conducted with the Colorado State University data and then the model was confirmed using data from the other locations. In each case the effect of walkability on self-report

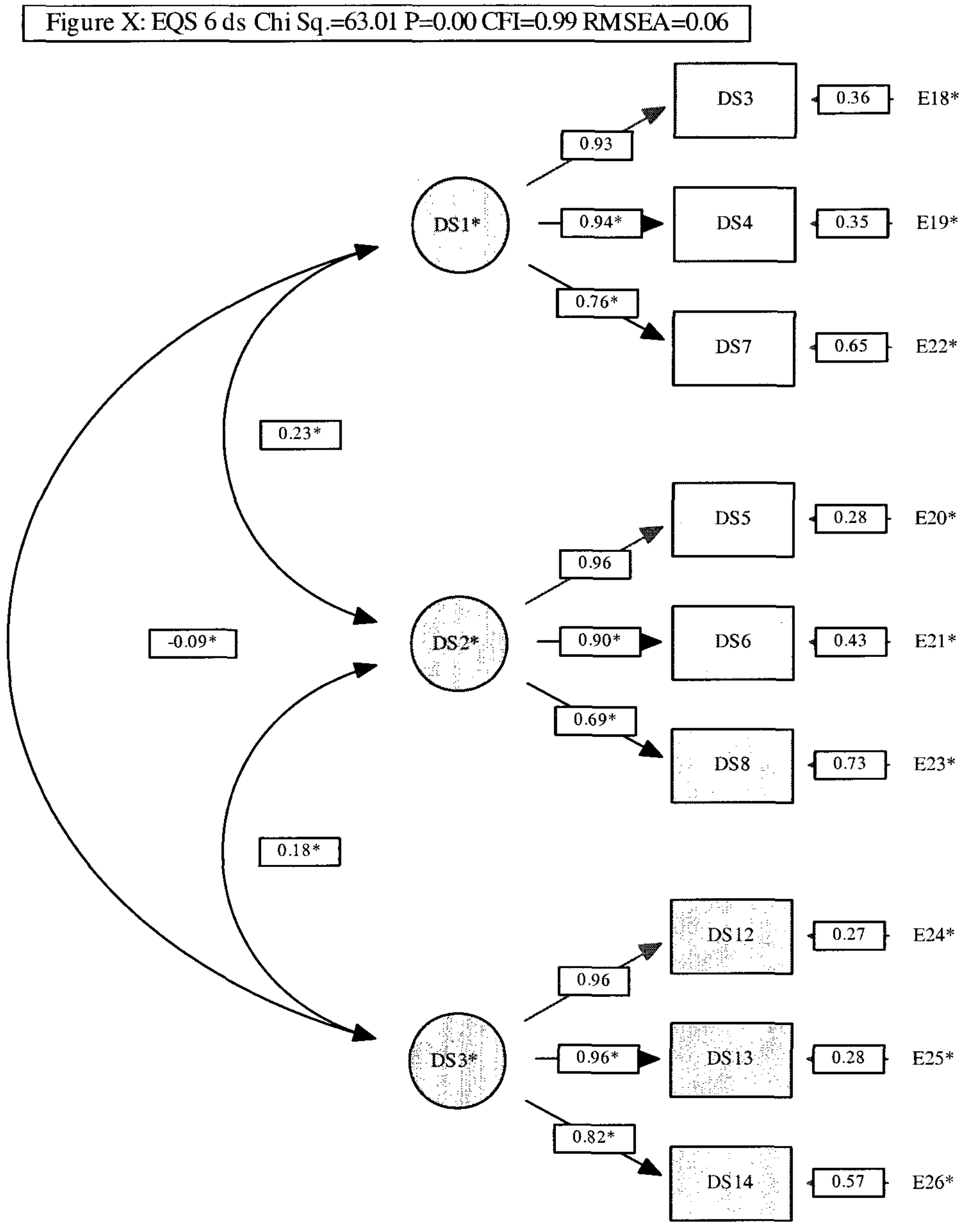


Figure 3. Covariance of descriptive norms.

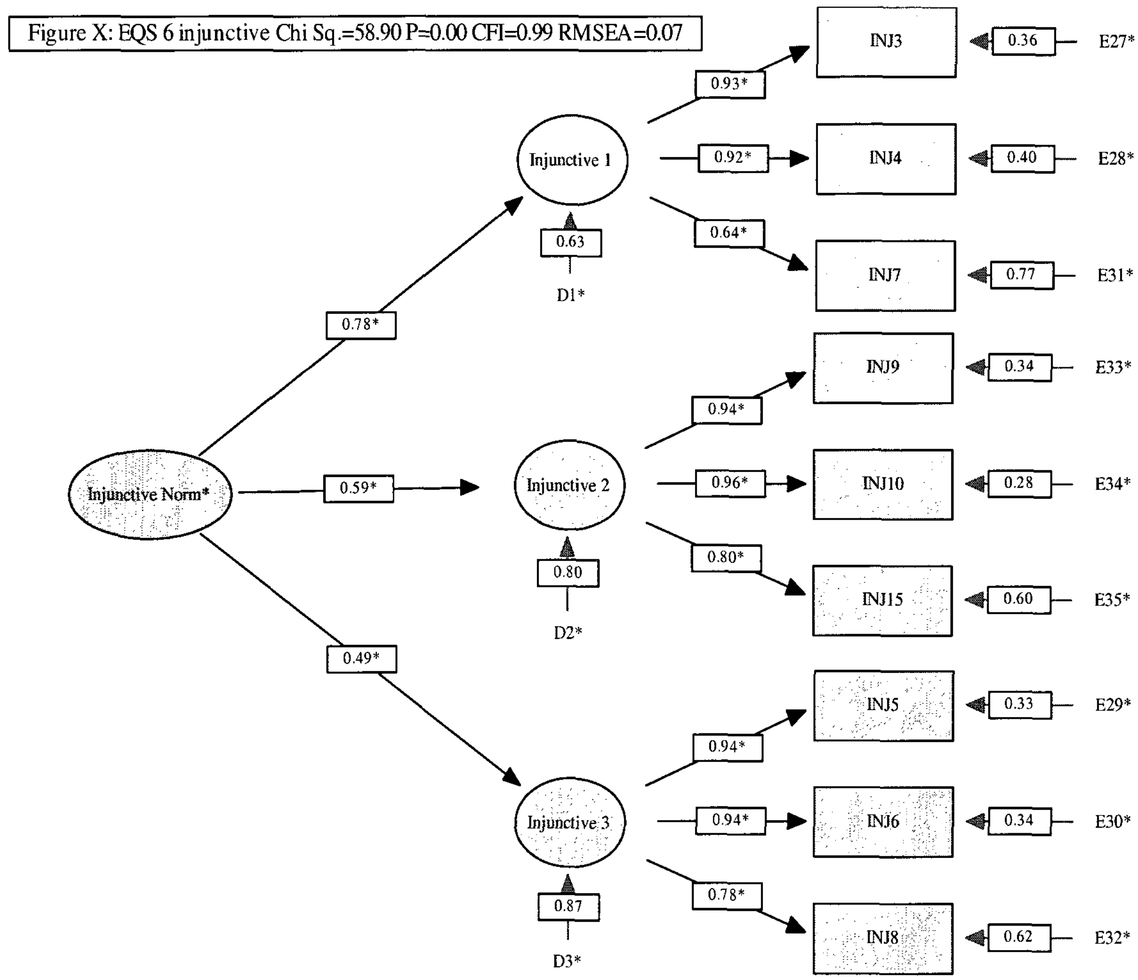


Figure 4. Factor structure of injunctive norms.

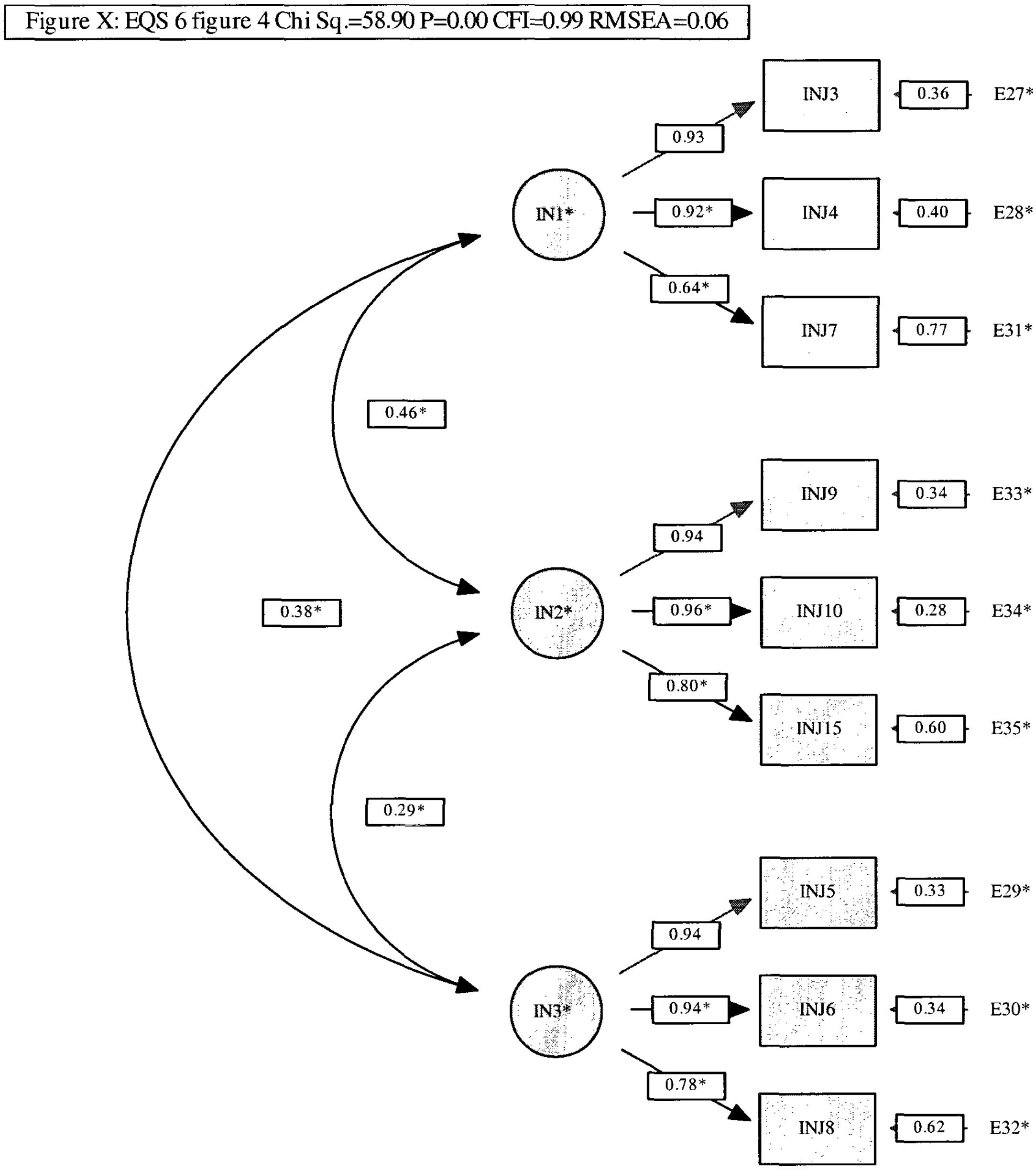
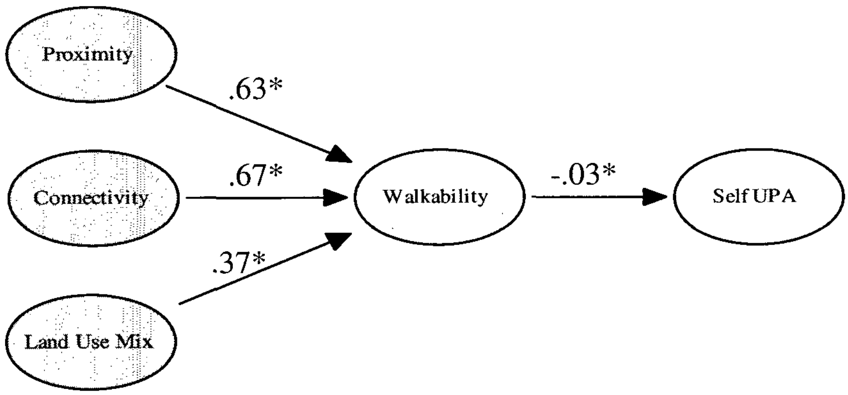
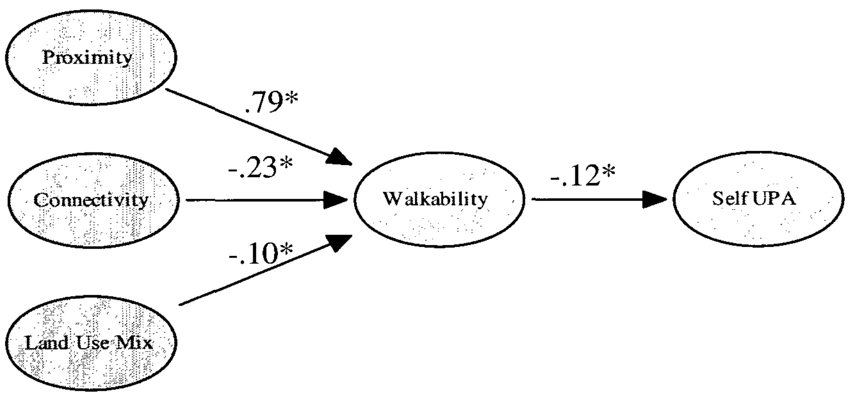


Figure 5. Covariance of injunctive norms.

CSU M6del – Chi Sq. = 324.93, P = 0.00 CFI = .78 RMSEA = 0.12



Utah Model – Chi Sq. = 153.68, P = 0.00 CFI = .83 RMSEA = .12



CU Boulder Model – Chi Sq. = 240.05, P = 0.00 CFI = .82 RMSEA = .12

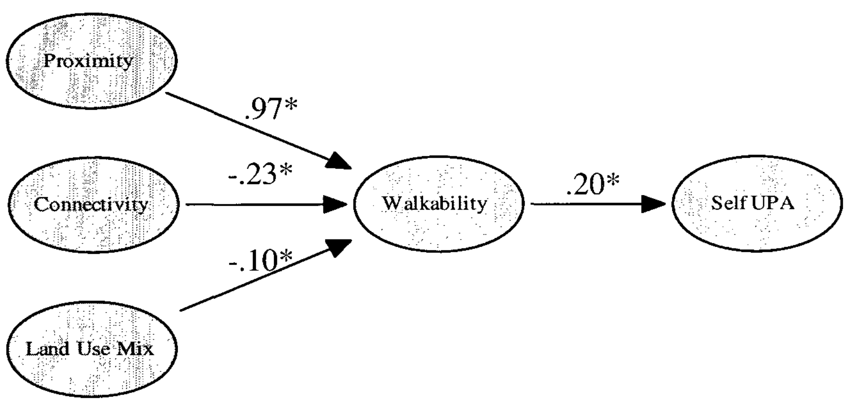


Figure 6. Initial model of walkability on self-UPA.

UPA disappeared completely when descriptive and injunctive norms were included in the model as mediators, and the only direct effects from walkability were to descriptive and injunctive norms (see Figure 7). Additionally, a formalized Sobel test found that the t-statistic for mediation through the descriptive norm was, $t = 3.19$, $p = .001$, while a Sobel test for mediation through the injunctive norm was, $t = 3.70$, $p = .0002$. Thus, Hypothesis 1 was fully supported. Table 2 shows individual steps of the mediation analysis with the full data set.

Hypothesis 2 stated that the effect of peer behavior—the amount of UPA engaged in by peers—on self UPA would be partially mediated by descriptive norms. Analysis revealed that peer behavior was directly related to the amount of UPA engaged in by self. There was an initially small effect from descriptive norms directly to self UPA; however, when peer UPA was entered into the structural model, this pathway became insignificant. To investigate the possibility that these two factors were really part of the same larger construct, a factor model was conducted using the full data set, and showed that the covariance between these two factors was quite low (see Figure 8). This indicates that these really are two distinct constructs and that the second hypothesis was not supported. Indeed, using Sobel's test for mediation it appears that rather than having the effect of peer behavior partially mediated by descriptive norms ($t = 3.01$, $p = .003$), it appears that the effect of descriptive norms on self UPA was fully mediated by peer behavior, ($t = 4.78$, $p = .000001$). Table 3 shows the steps of the mediation analysis using the full data set.

Hypothesis 3 stated that the effect of perceived safety on self UPA would be fully mediated through the latent variables of walkability and injunctive norms. Since the

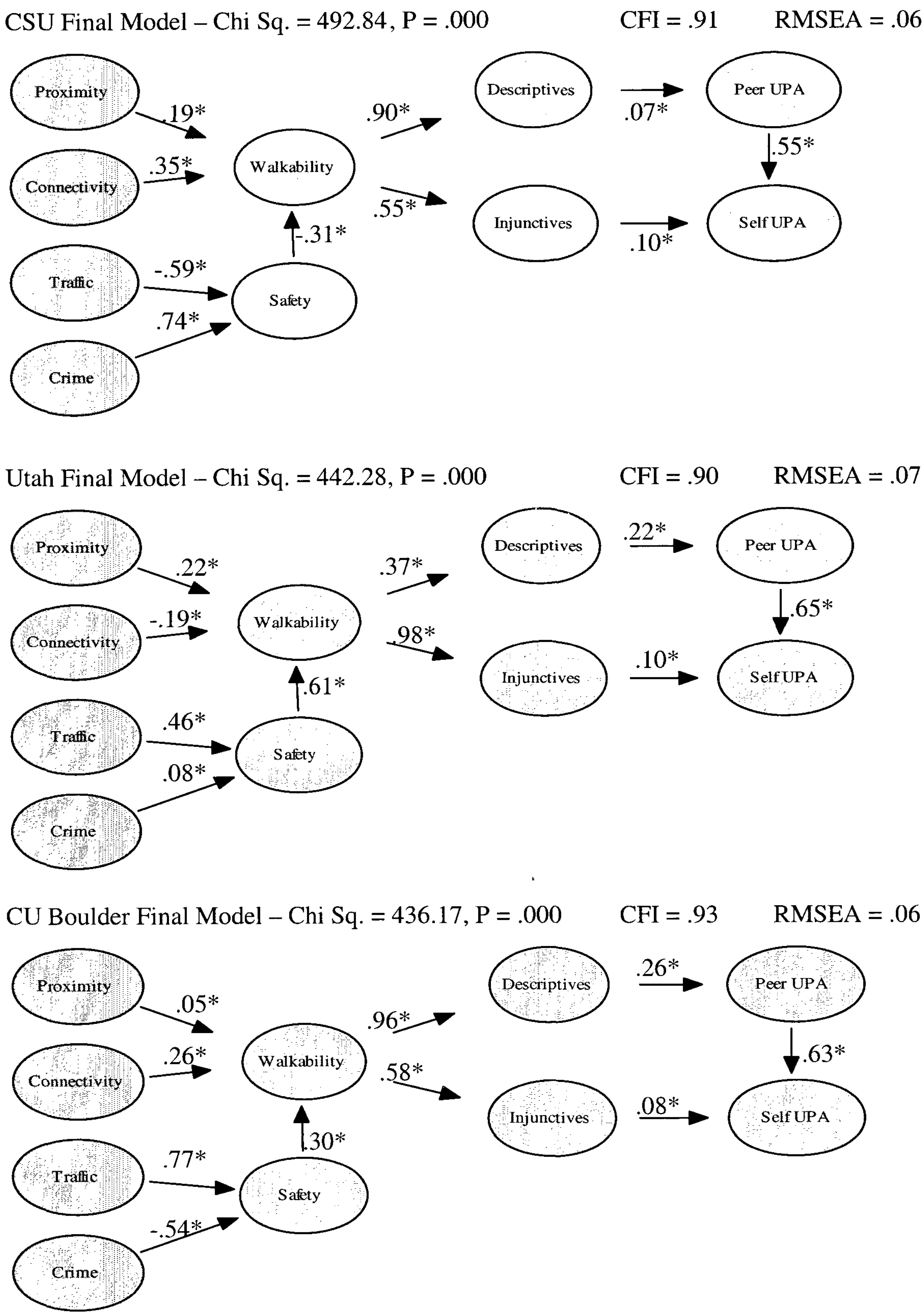


Figure 7. Final model of walkability on self-UPA through norms and peer behavior.

Table 2

Mediation Analysis of Descriptive and Injunctive Norms on UPA

	β	T value	Sig.
Walkability → UPA	.09	2.02	.04
Walkability → Descriptive	.21	5.58	.00
Walkability → Injunctive	.20	5.31	.00
Descriptive → UPA	.12	2.45	.02
Injunctive → UPA	.10	1.97	.05
Walkability → UPA	.05	1.17	.24
Descriptive → UPA	.11	2.20	.03
Injunctive → UPA	.09	1.99	.05

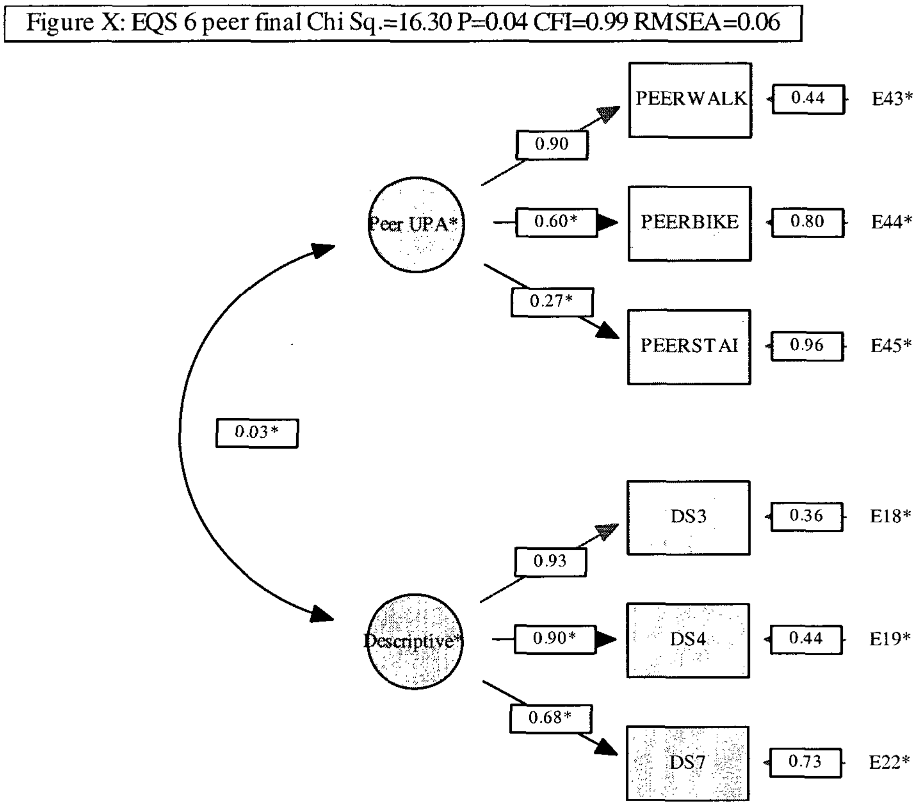


Figure 8. Covariance of peer-UPA and descriptive norms.

Table 3. *Mediation Analysis of Descriptive Norms on Peer Behavior and UPA*

	β	T value	Sig.
Peer UPA→ UPA	.44	11.19	.00
Peer UPA→ Descriptive	.24	5.71	.00
Descriptive → UPA	.16	3.94	.00
Peer UPA→ UPA	.07	1.65	.10
Descriptive → UPA	.45	11.29	.00

walkability effect on self UPA was mediated by injunctive norms, separate analyses for each were conducted. When examining the role of perceived safety directly onto self UPA a strong effect was found ($\beta = .91$ at CSU); however once other variables were included this direct effect to UPA disappeared completely. When walkability and injunctive norms were both entered into the model it became clear that the effects of perceived safety were fully mediated through walkability. Again, a Sobel's mediation analysis confirmed this, $t = 2.16$, $p = .04$. The path from perceived safety to injunctive norms was found to be non-significant. Based on these findings Hypothesis 3 received partial support. The role of perceived safety was indeed mediated through walkability as predicted; however, the mediation through injunctive norms was not supported. Using the full data set, steps of the mediation analysis are depicted in Table 4.

Discussion

Although the final model (conceptually shown in Figure 9) only supported one hypothesis fully and another partially, it does fully support the overall research question, namely that the built environment does provide normative information and that the information about norms is in turn used to determine utilitarian physical activity. The model shown demonstrates that the effect of the built environment is much more complex than many modern urban planners had thought. This is an important finding that has the potential to change how planners and architects view the environment. At a minimum it implies that to effectively alter behaviors related to UPA, consideration of psychological constructs is required. Since the present study created a model using data from one university, then replicated the findings with data from two other universities, it provides

Table 4

Mediation Analysis of Walkability and Injunctive Norms on Safety and UPA

	β	T value	Sig.
Walkability			
Safety → UPA	.59	17.12	.00
Safety → Walkability	.24	6.38	.00
Safety → Injunctive	.02	.52	.61
Walkability → UPA	.09	2.02	.04
Safety → UPA	.08	1.81	.07
Walkability → UPA	.12	2.78	.03

confidence that the model is valid and not the result of a fluke in the data. Whether this model would generalize beyond university samples remains to be seen.

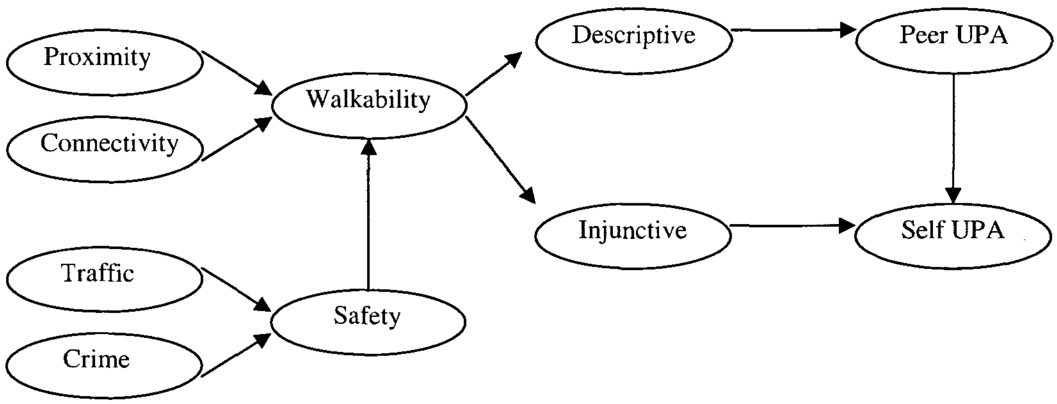


Figure 9. Final conceptual model of built environment, norms and UPA.

There were a couple of interesting developments in the current study. First, it appears that this study is the first to analyze scales from the Minnesota Twin City Walking Survey and provide reliability and factor information for these scales. While the scales appear to have relatively high face validity, each of the scales was able to be refined considerably. However, since this sample was entirely on and near college campuses, it may be that some of the items discarded in the present study hold up well when data are collected from a community sample. Even if this is the case, the present findings indicate that researchers need to use considerable caution when utilizing measures related to walkability. Clearly, further measurement related work is needed to refine scales, and it is plausible that different scales are needed for different situations (e.g., university campuses, communities).

The fact that land use pattern was not a valid indicator of walkability on college campuses reinforces the need for situation specific scales. On further investigation of the data, land use mix showed the most range restriction of all constructs. While the full range of the 6-point scale was utilized, over 90% of the responses utilized only the top half of the scale, indicating that land use mix was considered quite high by all participants. In retrospect, this should be expected. Many college students live on or close to campus and in many college communities the area surrounding the campus is a mix of residences, restaurants and other stores. Looking at maps of many college campuses, it would appear that most were planned and constructed according to Perry's neighborhood unit plan, which maintained that each neighborhood should be entirely self-contained with schools, stores, recreational areas, and other amenities (Frank et al., 2003; Perry, 1929). Whether this has been done purposely or if this has been in response to the economic demand of college students remains unclear.

The measurement issues noted above may be why most researchers are currently favoring the use of objective measures of the built environment (Geographic Information Systems, Satellite Imaging) rather than the subjective type of measures utilized in the current study. However, using objective measurement, common effect sizes of the built environment on UPA range from .03 to .08; the current study, which utilized subjective measurement of the built environment, found effect sizes ranging from .03 – .20. While it seems natural that urban planners would lean towards researching methods that are more objective, this focus may be limiting the effectiveness of research and interventions.

Related to these measurement issues was the somewhat surprising finding of distinct descriptive norms for three locations. All prior literature has treated UPA as a single construct rather than specifying which type of UPA people should practice. While the three norms found—on-campus, off-campus, indoors—did hold together for a secondary factor of UPA, data analysis showed that each needs to be treated separately. It may be that these different descriptive norms are representative of different referent groups. Specifically, it may be that the location (i.e., on- or off-campus) makes salient a different referent group that the student uses for comparison. If this is correct, features of the built environment are interpreted differently based on the social comparisons being made, or the salient group membership. However, it could also be that the built environment is structured differently enough in each of the different situations that the built environment is providing substantially different normative data to the individual. This dilemma should receive further attention since it implies extremely different interventions. If the first explanation is correct, then social interventions would be highly effective; however, if it is the second explanation that is correct, intervention would require remodels, and rebuilding.

It was also surprising to see different injunctive norms related to each of the descriptive norms. Although distinct, the injunctive norms were more related to each other and suggest that people's idea of what is valued remains relatively stable across situations. Thus, it would appear that while interventions would need to target different descriptive norms, targeting a single injunctive norm related to UPA or physical activity would be sufficient.

The findings related to descriptive and injunctive norms suggest multiple possible interventions. In all cases the focus theory of normative behavior would be essential, as you would want to align the injunctive and descriptive norms in the same direction and make them salient. However, one intervention would be direct and would activate norms related to UPA. One benefit of this is that activation of these norms would not depend on the walkability of the area. It would be expected that the walkability quotient for the area would interact with the intervention and alter the effectiveness accordingly. This interaction may be why many community-based physical activity interventions show such a wide range of effectiveness, and implies that walkability is a detail that health professionals should not overlook in their interventions.

An alternative solution would be to utilize a more indirect path and activate norms related to walkability or the environment. In this instance the goal would be to use normative information to influence the perception of walkability. Declaring that most people find the environment convenient for UPA could alter the perceptions of the environment itself. As perceptions of the environment are altered, this should in turn work its way down to behavior. Given the model shown it should be expected that this method would result in a relatively small effect on actual behavior, probably similar to the effects seen when actual environments are changed. The benefit with this strategy is that it might be possible to alter perceptions of the environment without actually needing to change the environment, which would be much more cost effective.

A third alternative would be to use norms to activate environmental concern. Qualitative data from other studies suggest that there is a wide range of reasons why people engage in UPA. One of the top three reasons provided is concern for the environment (Szlemko et al., in review). This may be an especially attractive intervention given the increasing environmental awareness combined with rising prices of fuel.

Based on Study 1 it is clear that considerably more research is required on measurement and scale development issues, including scales to examine walkability inside of buildings, and motivational scales. Additionally, the findings suggest multiple interventions for increasing UPA that should be investigated. One of the more intriguing possibilities is that of referent group salience influencing perceptions of the built environment. While the current study suggests many future directions, the data are entirely correlational and experimental studies need to be conducted.

CHAPTER THREE

STUDY 2

The major goal of Study 1 was to establish correlationally that perceived environmental design is related to descriptive and injunctive norms which in turn predict UPA. Data collection at multiple university sites provided variance in environmental design, thus allowing the proposed model to be tested. While structural equation modeling is a powerful statistical method it cannot show causation without a manipulation. The purpose of the second study was to experimentally manipulate environmental design and to evaluate the effect on descriptive and injunctive norms related to UPA. Following norm focus theory, low and high levels of UPA-related descriptive norms were crossed with low and high levels of UPA-related injunctive norms.

Hypotheses

1) In terms of perceived percent use the conditions would rank order as follows: 1) high injunctive, high descriptive, 2) low injunctive, high descriptive, 3) high injunctive, low descriptive, and 4) low injunctive, low descriptive.
2) Participants would indicate more likelihood of using UPA themselves when both injunctive and descriptive norms were high than when they were both low.

Method

Participants

Three hundred and eighty-three students (M = 19.36, SD = 1.58) who were enrolled in general psychology classes completed a series of photographic evaluations and surveys in partial fulfillment of course credit. Participants were 59% female and were predominantly college freshmen (87%). A total of 42 participants were excluded from analyses because they expressed suspicion about the hypotheses under study, or commented on some aspect of the photo manipulation looking not quite accurate. Interestingly, of the 38 who questioned the photo manipulations only 16 were accurate as to what had been altered.

Design

The experimental design consisted of two levels of injunctive norm for bicycle use (high, low) crossed with two levels of descriptive norm for bicycle use (high, low), crossed with four different campus buildings. Thus, there were 16 cells (2 x 2 x 4) in the complete design, consisting of four norm conditions (HH, HL, LL, LH) crossed with four buildings (B1, B2, B3, B4). However, each participant was exposed to only four cells of the design, but the four cells combined included each of the four norm conditions and each of the buildings. For example, a participant might see B1HH, B2HL, B3LL, B4LH, or might see B3HL, B4LL, B1LH, B2HH. Using subsets of the sample, this design allowed testing the 2x2 norm effects between-subjects at each building to make sure the effects generalized across settings, but also allowed testing the 2x2 norm effects within-subjects for the full sample with building randomized.

Materials

Four original photos of a campus building were obtained, one from each of four different campuses. Photos were manipulated within Adobe Photoshop in multiple ways (see Appendix G). Bike racks were added or removed, and bikes within racks were added or removed. Photos were accompanied by a short description of the location that included information about the size of the community or school where the photo was taken. This information was held constant across all conditions. Filler slides included two wooded bicycle paths, two roads with bicycle lanes, and two public parks.

Each photo, including filler slides, was assessed using a series of questions that inquired about perceived safety, perceived percent of the population that used the feature, likelihood of participants using feature, likelihood of their friends using the feature, perceived ease of engaging in UPA, and other factors (see Appendix H). Thus, the independent variables were the number of bike racks, and the number of bikes in the racks. Dependent variables of interest were the perceived percent of the population that used UPA, and the likelihood of the participants and their peers using UPA.

The perceived percent of the population that used UPA ($\alpha = .78$) was calculated as the composite of questions about what percent of students on that campus would either walk or bicycle to class regularly, combined with Likert-type response questions about whether a high percentage of people in the area walk or bike to the location shown. Thus, the perceived population use was calculated using responses to four questions (items 12, 13, 29, 30).

Likelihood of peers using UPA ($\alpha = .85$) in the area was calculated by summing the answers to two questions (items 10, 11) about the likelihood of friends walking or bicycling to the area shown if they lived within 1 mile of the location. Likelihood of self use of UPA ($\alpha = .82$) was calculated by summing two questions (items 8, 9) about the participant walking or bicycling to the destination if he or she lived within 1 mile and a single item (item 21) stating how likely the participant would be to walk or bicycle to class if he or she lived on or near that campus.

Procedure

Participants completed the study in groups of up to 14 participants per session. After completion of an informed consent, participants were given a packet of questions. Pictures were projected on a screen in the front of the room, and participants were allowed 3 minutes to complete the questions associated with each picture. Of the ten slides shown, manipulations were placed in locations 3, 5, 8, and 10. This placement allowed for two practice trials before participants were evaluating any of the manipulations while still spacing out manipulations to avoid suspicion of hypotheses. All other positions were occupied by filler slides. To eliminate order effects, the order in which filler slides were presented was determined by random number generator prior to each data collection session. Similarly, order of manipulation conditions was also determined by random number generator prior to each data collection session. Thus, no two data collection sessions received manipulations or fillers in the same order. Although every possible order was not used, this procedure allowed for variation between manipulations and fillers to a level that greatly reduced the chances of fatigue, practice effects, or order effects. Upon completion of the study participants were debriefed as to the purpose of the study and provided with researcher contact information.

Analysis

Each participant received each condition of subjective and descriptive norm manipulations (HH, HL, LH, LL). Although building was randomized across conditions, each building was represented within conditions. Within-subjects effects were analyzed with 2x2 ANOVAs, one for perceived percentage of the population using UPA, and one for likelihood of self use of UPA.

For between-subjects effects, building was held constant while subjective and descriptive norms were manipulated resulting in four conditions within each building (HH, HL, LH, LL). For each building a separate series of 2x2 ANOVAs was conducted with outcome variables for each building being the perceived percentage of the population using UPA, and the likelihood of self use of UPA. Thus, two analyses for each building were conducted, resulting in a total of 8 analyses examining the between-subjects effects.

Results

Since Study 1 demonstrated distinct differences in descriptive norms, and all Study 2 photographs were manipulated to a norm of bicycling, all Study 2 analyses were conducted on perceived use or likelihood of using a bicycle. Other forms of UPA, such as walking, are not reported, and indeed exploratory analysis showed that photograph manipulations did not influence perceived walking, but did influence perceived biking.

Manipulation Check

As a manipulation check approximately one-third of the participants were asked about the salient features or dominant characteristics in the pictures they were evaluating. A content analysis of responses to these open-ended questions revealed that participants did indeed pick up on the manipulations. In the high injunctive and high descriptive condition, 86% of participants mentioned the bike and/or bike racks as being what they noticed first about the picture. Typical examples are provided by participant 30 who said, "There are a lot of bikes in front of the building, there is no visible litter, there are also several trees and flower" or by participant 218 who stated, "There are lots of bikes, looks like most students ride."

In the high injunctive, low descriptive condition which had lots of bike racks but relatively few bikes, only about 61% mentioned bikes or bike racks. For those who did mention bikes or bike racks a typical response is similar to that given by participant 175 who said, "There is only one bike in front of this building, but there is a bike rack for many more." Among those who did not mention bikes a typical response focused on other aspects such as those mentioned by participant 346 who said, "This building is not very welcoming because there are only a few trees."

In the high descriptive, low injunctive condition which had few bike racks but those racks were relatively full, only about 39% of participants mentioned bikes or bike racks. Among those who did mention bikes or bike racks participant 199 provides a typical comment, "Nice architecture, could use some more bike racks, they are pretty full." However, most students simply did not even mention the bikes or bike racks and a typical response was similar to that of participant 176 who commented on the building and the surrounding area, "The building is very odd looking. I like the fact that it looks surrounded in trees and bushes."

In the final condition which was low descriptive and low injunctive as demonstrated by few bike racks and few bikes, less than 10% of participants mentioned anything to do with bikes or bike racks. A representative response was provided by participant 159 who said, "Lots of concrete, the sidewalk takes up the whole picture. It doesn't look like there is any grass near." Based on these analyses of both content and percent who selected bikes as a salient feature in the photographs, it would appear that participants were keyed in to the manipulations and that the manipulation was effective.

Hypothesis 1

Hypothesis 1 stated that participants would rank percent perceived use in this order: 1) high injunctive, high descriptive, 2) low injunctive, high descriptive, 3) high injunctive, low descriptive, and 4) low injunctive, low descriptive. This was analyzed both within persons and between persons. After controlling for aesthetic value of the different buildings, the within-persons analysis revealed that only the high high condition was significantly different from the other conditions, but the rank ordering of perceived percent use was as predicted (see Tables 5 and 6). Additionally, an ANCOVA with building aesthetics entered as the covariate found no main effect or interaction for aesthetics of the buildings. Additionally, for the between-persons analysis, the high injunctive, high descriptive condition consistently received the highest perceived percent use and the low injunctive, low descriptive condition generally showed the lowest perceived percent use. The middle conditions of high injunctive, low descriptive and low injunctive, high descriptive were not consistent and were not substantially different from each other. Although there were some unexpected and inconsistent outcomes, in general Hypothesis 1 was supported.

Table 5

Differences in Perceived Percent Use of UPA by Community Members

	DF	F	Sig.	Sig. Post Hoc
Within	3, 318	11.14	.000	1-4 (p = .006)
BLD 1	3, 338	5.90	.001	1-3(p = .001); 1-4 (p = .004)
BLD 2	3, 330	1.90	.129	--
BLD3	3, 323	3.16	.025	1-4 (p = .035)
BLD 4	3, 321	4.23	.005	1-4 (p = .005)

Table 6

Percent Perceived Use of UPA by Others by Condition

	Within Persons	Between Persons			
		Bld. 1	Bld. 2	Bld. 3	Bld. 4
High Injunctive High Descriptive	50.9%	53.2%	47.5%	50.4%	52.3%
Low Injunctive High Descriptive	45.9%	47.1%	45.5%	49.4%	47.4%
High Injunctive Low Descriptive	45.0%	42.6%	40.8%	46.4%	45.6%
Low Injunctive Low Descriptive	44.3%	41.2%	42.6%	41.8%	42.1%

Hypothesis 2

Hypothesis 2 stated that there would be an increase in reported likelihood of the participants using UPA depending on whether they were examining the high injunctive high descriptive condition versus the low injunctive low descriptive condition. As above, these analyses were limited to the information related to biking since the pictures were specifically manipulating this norm. After controlling for aesthetic value, the within-person analyses showed that the high, high condition received significantly higher ratings than the low, low condition (see Table 7). The between-person analyses showed that for each building the change in likelihood was in the hypothesized direction, although there were no statistically significant differences (see Table 7). Thus, there was only partial support for the second hypothesis.

Discussion

Results supported the first hypothesis that the manipulations would be rank ordered in such a fashion that when both descriptive and injunctive norms were in agreement, either high or low, perceived use was also at either a high or a low. This is not surprising since it is consistent with the focus theory of normative behavior. However, the intermediate conditions where descriptive and injunctive norms were contradictory were less clear and were not significantly different from each other, although it would appear that the descriptive norm is slightly more powerful than the injunctive norm. The high injunctive, high descriptive condition compared to the low injunctive, low descriptive condition appeared to result in a difference of about 7 – 8% change in perceived use.

Table 7

Mean Differences in Likelihood of Self Use of UPA between HH and LL Conditions

	Mean (SD)				
	HH	LL	DF	F	Sig.
Within	4.24 (1.02)	4.15 (1.09)	1, 324	3.87	.05
BLD 1	4.32 (0.95)	4.29 (1.10)	1, 267	0.02	.88
BLD 2	4.19 (1.08)	4.16 (1.16)	1, 265	0.02	.90
BLD3	4.24 (0.99)	4.10 (1.07)	1, 266	0.74	.39
BLD 4	4.22 (1.06)	4.07 (1.03)	1, 261	0.83	.37

The second hypothesis was partially supported; the within-subjects analysis found more self-use of UPA in the high-high than low-low condition, but the manipulations to the photographs did not substantially influence the likelihood of self UPA use in the between-subjects analyses. This is consistent with the findings of the first study that show that the effect of a change in the environment has to go through other variables before reaching self behavior. Since each of the between-subjects differences was in the predicted direction, it may be that these missing mediating variables were eliminating the effect. Alternatively, it may be that the relatively small change depicted in the manipulated photographs was not sufficient to create an observable effect. If the photographs included not only bike racks and bikes, but also other features (e.g., bike lanes, people walking), these may have combined and created a more robust manipulation that could have produced an observable effect.

The fact that perceived use by others was affected while likelihood of self use did not change could be the result of students simply not recognizing what actually influences their behavior. There are many studies, including Study 1, that show that descriptive norms do influence behavior, so the fact that participants recognized differences in perceived percent use, which is analogous to the descriptive norm, suggests that there should be a change in behavior—even if students do not realize it. Another possibility is that since the descriptive norm is defined as what most people do, and the percent perceived use was relatively low (53% in the highest condition), then the descriptive norm may not have reached the threshold required to truly influence behavior. Many studies that do show effects based on manipulation of norms typically use a descriptive norm of 70% or higher. There may be a threshold that must be reached for a descriptive norm to exert its influence on behavior. This is a further line of research that should be pursued since determining a threshold—especially if it is robust across situations—would have the potential to greatly aid interventions of many types.

The open-ended manipulation check suggests that when people are actively evaluating an environment, they do notice relatively small changes to the built environment. Unfortunately, it is unclear if people would still notice these changes without active evaluation. According to the focus theory of normative behavior, the effect of norms on behavior is largely limited to norms that are salient (Cialdini et al., 1990). This suggests that the environment could be changed considerably, yet if individuals are not aware or paying attention to those changes, the desired norms may not become salient. Since evaluation research of the type done here requires participants to be paying attention, other research is needed to see what effects are observed when participants are not actively evaluating their environment. This could be accomplished either through virtual designs or through field studies that would manipulate the environment itself. Clearly, the virtual version is the more cost effective method of examination, but it may also be limited in that it is still not real behavior.

CHAPTER FOUR

GENERAL DISCUSSION AND COMMENT

Study 1 showed that built environment factors that urban planners and public health officials have identified do form a secondary factor of walkability. Consistent with planning and health literature, there was a small effect of walkability on UPA. However, when descriptive and injunctive norms were entered into the model, this pathway disappeared, and was fully mediated by those norms. Although based on correlational data, this suggests that the mechanism through which the built environment influences behavior is through supplying normative data.

Study 2 was designed to experimentally manipulate the environment in a photograph to determine whether those changes would influence perceived use of UPA (descriptive norm) and likelihood of self use of UPA. The manipulations did influence perceived use (descriptive norm) but had weaker influence on likelihood of self use. This does support the conclusion from Study 1 that the built environment provides information about social norms.

Together these studies form an important first step in developing a theoretical explanation for how the built environment operates on behavior. Much prior research on how the built environment operates has been limited to trial-and-error methods, which has meant that designers, architects, and urban planners have had less of an idea of how their designs would influence behavior prior to their being built. A logical next step in the process of developing this theoretical explanatory mechanism would be to create virtual environments or to engage in small relatively inexpensive changes to real environments and document changes in perceived norms and changes in behavior. For example, it would be interesting to provide schools that have no bike rack with a bike rack and measure changes. Or, for schools that already have bike racks, one could provide bikes that could be locked into the racks (thus altering the perceived use or descriptive norm) and measuring changes. Interestingly, something similar to this process could be achieved through archival data, or pre- post data if timed right. Some towns, including Fort Collins, have bought bicycles that are supposed to be for community use. If data were available from before and after, or could be collected before and after, this would provide an interesting insight into the process. Of course with this method there is the additional confound of the availability of a bike to use. Still, this could provide important confirmatory evidence.

Although it is well documented that exercise interventions are largely ineffective (Thomas, 2006), UPA has the potential to greatly increase physical activity. Study 1 showed that there were distinctly different norms available for each of three types of UPA; however, Study 2 suggests that a more salient descriptive norm is needed to reach a threshold where individual behavior would change. Although this was related to UPA, it could be a major reason why exercise interventions generally fail. Since each exercise intervention is different, and since according to the Centers for Disease Control and Prevention website most Americans do not exercise, part of the failure could be attributed to contradictory norms. Specifically, health professionals and organizations are creating the injunctive norm that we should exercise, but the descriptive norm that we typically see is that most people do not exercise. Thus, these norms are in conflict and could be reducing the effectiveness of many interventions. If this is the case, perhaps changing the referent group would be an effective way of increasing the perceived descriptive norm.

Based on the findings in the present studies, interventions that directly manipulate norms, related to either UPA or walkability, should be investigated. However, some less obvious research studies would include an examination of weather effects. Typically, we assume that poor weather would reduce UPA, but this may not be the case if the environment is structured properly. For example, University of Minnesota, Duluth among others has tunnels that allow students to get from building to building without having to go outside when the weather is poor. Construction such as this may actually have an inverse interaction with poor weather such that poor weather may actually increase UPA rather than decreasing it. Studies could utilize longitudinal data collection and observational techniques that select random time samples of UPA both inside and outside, and number of cars in the parking lot.

Although UPA shows much promise for health interventions there is still considerable work to be done. Prior examinations of UPA consistently treat all UPA as equal; Study 1 clearly showed that this is not the case and that different norms exist for different types of UPA. Although data were collected using a college student sample, it is reasonable to assume that even in larger communities there are multiple norms. Perhaps because UPA has been treated as a single variable there is little or no reliable mechanism for measuring UPA inside of buildings; additionally, there may need to be different measurement instruments depending on whether the UPA is work-related or not.

As more people around the world start living in urban communities, and gain access to technologies of convenience, UPA and designs that enhance UPA will become increasingly important. Without a theoretical mechanism it will be a long process to refine our building and planning strategies. These studies took an initial step in this process and provide a potential mechanism that may guide future research and planning and building projects.

REFERENCES

American Public Health Organization. *America's health rankings report.* (2005) Presented at the American Public Health Association annual conference.

Amra, B., Rahmani, A., Salimi, S., Mohammadzadeh, Z., & Golshan, M. (2005). Association between asthma and body mass index in children. *Iranian Journal of Allergy and Asthma Immunology, 4(1), 33-37.*

Andersen, R. E., Blair, S. N., Cheskin, L. J., & Bartlett, S. J. (1997). Encouraging patients to become more physically active: the physician's role. *Annals of Internal Medicine, 127(5),* 395-400.

Andersen, R. E., Franckowiak, S. C., Snyder, J., Bartlett, S. J., & Fontaine, K. R. (1998). Can inexpensive signs encourage the use of stairs? Results from a community intervention. *Annals of Internal Medicine, 129,* 363-369.

Antonakos, C. (1995). Nonmotor travel in the 1990 Nationwide Personal Transportation Survey. *Transportation Research Record, 1502,* 75-81.

Ashe, M., Jernigan, D., Kline, R. & Galaz, R. (2003). Land use planning and control of alcohol, tobacco, firearms and fast food restaurants. *American Journal of Public Health, 93(9),* 1404-1409.

Atkinson, J.A., Sallis, J.F., Saelens, B.E., Cain, K.L. & Black, J.B. (2005). The association of neighborhood design and recreational environments with physical activity. *The American Journal of Health Promotion, 19(4),* 304-309.

Austin, S.B., Melly, S.J., Sanchez, B.N., Patel, A., Buka, S. & Gortmaker, S.L. (2005). Clustering of fast food restaurants around schools: A novel application of spatial statistics to the study of food environments. *American Journal of Public Health, 95(9),* 1575-1582.

Backhed, F., Manchester, J. K., Semenkovich, C. F., & Gordon, T. I. (2007). Mechanisms underlying the resistance to diet-induced obesity in germ-free mice. *Proceedings of the National Academies of Science, 104(3),* 979-984.

Baron, R. M., Mandel, D. R., Adams, C. A., & Griffen L. M. (1976). Effects of social density in university residential environments. *Journal of Personality and Social Psychology, 34,* 434-446.

Baum, A., & Paulus, P. B. (1987). Crowding. In D. Stokols & I. Altman (Eds.), *Handbook of environmental psychology* (Vol I, pp. 533-570). New York: Wiley Interscience.

Beatley, T. (2000). *Green urbanism: Learning from European Cities.* Washington, D.C.: Island Press.

Bentler, P.M. (1989). *EQS, Structural equations program manual, Program Version 3.0,* Los Angeles: BMDP Statistical Software, Inc.

Berke, E. M., Koepsell, T. D., Moudon, A. V., Hoskins, R. E., & Larson, E. B. (2007). Association of the built environment with physical activity and obesity in older persons. *American Journal of Public Health, 97(3),* 486-492.

Blair, S.N., Kohl, H.W., & Gordon, N.F. (1992). Physical activity and health: A lifestyle approach. *Medicine, Exercise, Nutrition, and Health, 1*, 54-59.

Bowden, R., Rust, D., Dunsmore, S., & Briggs, J. (2005). Changes in social physique anxiety during 16-week physical activity courses. *Psychological Reports*, *96*(3), 690-692.

Brisbon, N., Plumb, J., Brawler, R., & Paxman, D. (2005). The asthma and obesity epidemics: The role played by the built environment – a public health perspective. *Journal of Allergy and Clinical Immunology, 115(5),* 1024-1028.

Brown, J. D. (1991). Staying fit and staying well: Physical fitness as a moderator of life stress. *Journal of Personality and Social Psychology, 60*, 555-561.

Burke, G., Arnold, A., Bild, D., Cushman, M., Fried, L., Newman, A., et al. (2001). Factors associated with healthy aging: The Cardiovascular Health Study. *Journal of the American Geriatrics Society*, *49*(3), 254-262.

Buunk, B. P., & Baker, A. B. (1995). Extradyadix sex: The role of descriptive and injunctive norms. *Journal of Sex Research, 32,* 313-318.

Byrne, B. M. (1994). *Structural equation modeling with EQS and EQS/Windows: Basic concepts, applications, and programming.* Thousand Oaks, CA: Sage.

Castro, C., Wilcox, S., O'Sullivan, P., Bauman, K., & King, A. (2002). An exercise program for women who are caring for relatives with dementia. *Psychosomatic Medicine*, *64*(3), 458-468.

Carter, M.A. & Swinburn, B. (2004). Measuring the obesogenic food environment in New Zealand primary schools. *Health Promotion International, 19(1),* 15-20.

Cervero, R. (1988). Land use mixing and suburban mobility. *Transportation Quarterly, 42(3),* 429-446.

Cervero, R., & Duncan, M. (2003). Walking, bicycling, and urban landscapes: Evidence from the San Francisco Bay area. *American Journal of Public Health, 93(9),* 1478-1483.

Cevero, R., & Kockelman, K. (1997). Travel demand and the 3Ds: Density, diversity and design. *Transportation Research Part D, 2(3),* 199-219.

Ceschi, M., Gutzwiller, F., Moch, H., Eichholzer, M., & Probst-Hensch, N. M. (2007). Epidemiology and pathophysiology of obesity as a cause of cancer. *Swiss Medicine Weekly, 137(3-4),* 50-56.

Cialdini, R. B (2003). Crafting normative messages to protect the environment. *Current Directions in Psychological Science, 12(4),* 105-109.

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology, 58,* 1015-1026.

Chatzisarantis, N., & Hagger, M. (2005). Effects of a brief intervention based on the theory of planned behavior on leisure-time physical activity participation. *Journal of Sport & Exercise Psychology*, *27*(4), 470-487.

Chenoweth, D., & Leutzinger, J. (2006). The economic cost of physical inactivity and excess weight in American adults. *Journal of Physical Activity and Health, 3,* 148-163.

Chin, D.J., White, M., Harland, J., Drinkwater, C., & Raybould, S. (1999). Barriers to physical activity and socioeconomic position: implications for health promotion. *Journal of Epidemiological Community Health, 53,* 191-192.

Clark, D., Stump, T., & Damush, T. (2003). Outcomes of an Exercise Program for Older Women Recruited Through Primary Care. *Journal of Aging and Health*, *15*(3), 567-585.

Courneya, K., Conner, M., & Rhodes, R. (2006). Effects of different measurement scales on the variability and predictive validity of the 'two-component' model of the theory of planned behavior in the exercise domain. *Psychology & Health*, *21*(5), 557-570.

Courneya, K., Friedenreich, C., Quinney, H., Fields, A., Jones, L., & Fairey, A. (2004). Predictors of adherence and contamination in a randomized trial of exercise in colorectal cancer survivors. *Psycho-Oncology*, *13*(12), 857-866.

Crane, R. (1999). *The impacts of urban form on travel: A critical review.* Cambridge, MA: Lincoln Institute of Land Policy Working Paper No. WP99RC1.

Crews, D. J., & Landers, D. M. (1987). A meta-analytic review of aerobic fitness and reactivity to psychosocial stressors. *Medicine and Science in Sports and Exercise, 19,* S114-120.

D'Atri, D. A., Fitzgerald, E. F., Kasl, S. V., & Osterfeld, A. M. (1981). Crowding in prison: The relationship between changes in housing mode and blood pressure. *Psychosomatic Medicine, 43(2),* 95-105.

Darley, J. M., & Latané, B. (1968). Bystander intervention in emergencies: Diffusion of responsibility. *Journal of Personality and Social Psychology, 8,* 377-383.

Dunphy, R., & Fisher, K. (1994). Transportation, congestion, and density: New insights. *Transportation Research Record, 1552*, 89-96.

Erem, C., Arslan, C., Hacihasanoglu, A., Deger, O., Topbas, M., Ukinc, K., et al. (2004). Prevalence of obesity and Aoassociated risk factors in a Turkish population (Trabzon City, Turkey). *Obesity Research, 12*(7), 1117-1127.

Ernsberger, P., & Koletsky, R. J. (1999). Biomedical rationale for a wellness approach to obesity: An alternative to a focus on weight loss. *Journal of Social Issues, 55*, 221-259.

Etkin, C., Prohaska, T., Harris, B., Latham, N., & Jette, A. (2006). Feasibility of implementing the Strong for Life Program in community settings. *The Gerontologist*, *46*(2), 284-292.

Evans. G. W. (1979). Behavioral and physiological consequences of crowding in humans. *Journal of Applied Social Psychology, 9,* 27-46.

Evans, G. W., Lepore, S. J., Shejwal, B. R., & Palsane, M. N. (1998). Chronic residential crowding and children's well-being: An ecological perspective. *Child Development, 69,* 1514-1523.

Evans, G., Wells, N., & Moch, A. (2003). Housing and Mental Health: A Review of the Evidence and a Methodological and Conceptual Critique. *Journal of Social Issues*, *59*(3), 475-500

Evans, R. I. (2001). Social influences in etiology and prevention of smoking and other health-threatening behaviors in children and adolescents. In A. Baum, T. A., Revenson, & J. E. Singer (Eds.), *Handbook of Health Psychology* (pp. 459-568). Mahwah, NJ: Erlbaum.

Fallon, E., Hausenblas, H., & Nigg, C. (2005). The transtheoretical model and exercise adherence: Examining construct associations in later stages of change. *Psychology of Sport and Exercise*, *6*(6), 629-641.

Fanning, D. M. (1967). Families in flats. *British Medical Journal, 4,* 382-386.

Federal Highway Administration. (1997). *Our Nation's travel: 1995 NPTS early results report.* Washington, D.C.: U.S. Department of Transportation.

Fein, A. (1967). *Landscape into cityscape: Frederick Law Olmsted's plans for a Greater New York City.* Ithaca, NY; Cornell University Press.

Finkenberg, M., DiNucci, J., McCune, S., Chenette, T., & McCoy, P. (1998). Commitment to physical activity and anxiety about physique among college women. *Perceptual and Motor Skills*, *87*(3), 1393-1394.

Flegal, K. M., Carroll, M. D., Ogden, C. L., & Johnson, C. L. (2002). Prevalence and trends in obesity among U.S. adults, 1999-2000. *Journal of the American Medical Association,* 288, 1723-1727).

Finkelstein, E. A., Fiebelkorn, I. C., & Wang, G. (2003). National medical spending attributable to overweight and obesity: How much, and who's paying? *Health Affairs,* 22, 219-226.

Fisher, B.S. & Nasar, J.L. (1992). Fear of crime in relation to three exterior site features: Prospect, refuge and escape. *Environment and Behavior, 24(1),* 35-65.

Frank, L.D., Engelke, P.O., & Schmid, T.L. (2003). *Health and Community Design: The impact of the built environment on physical activity.* Washington, D.C.: Island Press.

Frank, L. D., & Pivo, G. (1995). Impacts of mixed use and density on utilization of three modes of travel: Single-occupant vehicle, transit, and walking. *Transportation Research Record, 1466,* 44-52.

Giles-Corti, B., Broomhall, M.H., Knuiman, M., Collins, C., Douglas, K., Ng, K., et al. (2005). Increasing walking: How important is distance to, attractiveness, and size of public open space? *American Journal of Preventive Medicine, 28,* 169-176.

Gomez, J.E., Johnson, B.A., Selva, M. & Sallis, J.F. (2004). Violent crime and outdoor physical activity among inner-city youth. *Preventive Medicine, 39,* 876-881.

Gordon, N.F., Kohl, H.W., & Blair, S.N. (1993). Life style exercise: A new strategy to promote physical activity for adults. *Journal of Cardiopulmonary Rehabilitation, 13*, 161-163.

Griffin-Blake, C., & DeJoy, D. (2006). Evaluation of social-cognitive versus stagematched, self-help physical activity interventions at the workplace. *American Journal of Health Promotion, 20*(3), 200-209.

Gruenewald, P., Ponicki, W., & Holder, H. (1993). The relationship of outlet densities to alcohol consumption: A time series cross-sectional analysis. *Alcoholism: Clinical and Experimental Research, 17*(1), 38-47.

Haefeli, U. (2001). *Public transport can pay. A historical analysis of transport policies in Bern (Switzerland) and Bielefeld (Germany) since 1950.* Paper presented at the 1st Swiss Transport Research Conference, Ascona, Switzerland, March 1-3, 2001.

Hallam, J., & Petosa, R. (2004). The long-term impact of a four-session work-site intervention on selected social cognitive theory variables linked to adult exercise adherence. *Health Education & Behavior, 31*(1), 88-100.

Hart, E. A., Leary, M. R., & Rejeski, W. J. (1989). The measurement of social physique anxiety. *Journal of Sport & Exercise Psychology, 11*, 94-104.

Hartman, J. (1993). The Delft bicycle network. In Rodney Tolley (Ed.), *The greening of urban transport: Planning for walking and cycling in Western cities.* London: Belhaven Press.

Hill, J.O. & Peters, J.C. (1998). Environmental contributions to the obesity epidemic. *Science, 280,* 1371-1374.

Hill, J.O., Peters, J.C., & Jortberg, B.T. (2004). *The step diet book: Count steps, not calories to lose weight and keep it off forever.* New York:Workman.

Holtzclaw, J. (1994). *Using residential patterns and transit to decrease auto dependence and costs.* National Resources Defense Council for California Home Energy Efficiency Rating Systems.

Hu, G., Pekkarinen, H., HÃ¤nninen, O., Yu, Z., Guo, Z., & Tian, H. (2002). Commuting, leisure-time physical activity, and cardiovascular risk factors in China. *Medicine & Science in Sports & Exercise, 34*(2), 234-238.

Hülsmann, W. (1993). The 'bicycle-friendly' towns project in the Federal Republic of Germany. In R. Tolley (Ed.), The greening of urban transport: Planning for walking and cycling in Western cities. London: Belhaven Press.

Jones, T. F., & Eaton, C. B. (1994). Cost-benefit analysis of walking to prevent coronary heart disease. *Archives of Family Medicine, 3(8),* 703-710.

Jones, M., & Nies, M.A. (1996). The relationship of perceived benefits of and barriers to reported exercise in older African American women. *Public Health Nursing, 13,* 151-158.

Juarbe, T., Turok, X.P., & Pérez-Stable, E.J. (2002). Perceived benefits and barriers to physical activity among older Latina women. *Western Journal of Nursing Research, 24,* 868-886.

Kahn, E.B., Ramsey, L.T., and Brownson, R.C. (2002). The effectiveness of interventions to increase physical activity: A systematic review. *American Journal of Preventative Medicine, 22*, 73.

Kallgren, C. A., Reno, R. R., & Cialdini, R. B. (2000). A focus theory of normative conduct: When norms do and do not affect behavior. *Personality and Social Psychology Bulletin, 26*(8), 1002-1012.

Keane, C. (1998). Evaluating the influence of fear of crime as an environmental mobility restrictor on women's routine activities. *Environment and Behavior, 30,* 60-74.

Lavrakas, P. (1982). Fear of crime and behavioral restrictions in urban and suburban neighborhoods. *Population & Environment: Behavioral & Social Issues*, *5*(4), 242-264.

Lindsay, J., Sykes, E., McDowell, I., Verreault, R., & Laurin, D. (2004). More Than the Epidemiology of Alzheimer's Disease: Contributions of the Canadian Study of Health and Aging. *The Canadian Journal of Psychiatry / La Revue canadienne de psychiatrie*, *49*(2), 83-91.

McTiernan, A., Kooperberg, C., White, E., Wilcox, S., Coates, R., Adams-Campbell, L. L., et al. (2003). Recreational physical activity and the risk of breast cancer in postmenopausal women: The Women's Health Initiative Cohort Study. *Journal of the American Medical Association, 290(10),* 1331-1336.

Maes, H. M., Neale, M. C., & Eaves, L. J. (1997). Genetic and environmental factors in relative body weight and human adiposity. *Behavioral Genetics, 27,* 325-351.

Marcus, B., King, T., Bock, B., Borrelli, B., & Clark, M. (1998). *Adherence to physical activity: Recommendations and interventions*. New York, NY, US: Springer Publishing Co.

Meyer, J. M., & Stunkard, A. J. (1994). Twin studies of human obesity. In C. Bouchard (Ed.), *The genetics of obesity* (pp 63-78). Boca Raton, FL: CRC Press.

Miller, W. C. (1999). Fitness and fatness in relation to health: Implications for aparadigm shift. *Journal of Social Issues, 55,* 207-220.

Mokdad, A., Bowman, B. Ford, E., Vinicor, F., Marks, J., Koplan, J. (2001). The continuing epidemics of obesity and diabetes in the United States. *Journal of the American Medical Association, 286* (10), 1195-1200.

Moudon, A., Hess, P., Snyder, M. & Stanilov, K. (1997). Effects of site design on pedestrian travel in mixed-use, medium density environments. *Transportation Research Record, 1578,* 48-55.

Nelson, A., & Allen, D. (1997). If you build them, commuters will use them: Association between bicycle facilities and bicycle commuting. *Transportation Research Record, 1578,* 79-82.

Norvell, N., & Belles, D. (1993). Psychological and physical benefits of circuit weight training in law enforcement personnel. *Journal of Consulting and Clinical Psychology, 61,* 520-527.

Okun, M., Karoly, P., & Lutz, R. (2002). Clarifying the contribution of subjective norm to predicting leisure-time exercise. *American Journal of Health Behavior, 26*(4), 296-305.

Okun, M., Ruehlman, L., Karoly, P., Lutz, R., Fairlholme, C., & Schaub, R. (2003). Social support and social norms: Do both contribute to predicting leisure-time exercise? *American Journal of Health Behavior, 27*(5), 493-507.

Paschali, A., Goodrick, G., Kalantzi-Azizi, A., Papadatou, D., & Balasubramanyam, A. (2005). Accelerometer feedback to promote physical activity in adults with Type 2 diabetes: A pilot study. *Perceptual and Motor Skills, 100*(1), 61-68.

Perry, C. (1929). The neighborhood unit. *In Neighborhood and Community Planning: Regional Survey, Volume VII.* New York: Committee on Regional Plan of New York and its Environs.

Plomin, R., DeFries, J. C., McClearn, G. E., & McGuffin, P. (2001). *Behavioral genetics* (4^{th} ed.). New York: Worth.

Prentice, D. A., & Miller, D. T. (1993). Pluralistic ignorance and alcohol use on campus: Some consequences of misperceiving the social norm. *Journal of Personality and Social Psychology, 64,* 243-256.

Pucher J, Lefevre C. 1996. *The urban transport crisis in Europe and North America.* London: Macmillan Press Ltd.

Pucher, J., & Dijkstra, L. (2000). Making walking and cycling safer: Lessons from Europe. *Transportation Quarterly, 54(3),* 25-50.

Reed, J. A., & Phillips, A. (2005). Relationships between physical activity and the proximity of exercise facilities and home exercise equipment used by undergraduate university students. *Journal of American College Health,* 53, 285-90.

Regoeczi, W. (2003). When context matters: A multilevel analysis of household and neighbourhood crowding on aggression and withdrawal. *Journal of Environmental Psychology, 23*(4), 457-470.

Rob, P., Niederstadt, C., & Reusche, E. (2001). Dementia in patients undergoing long-term dialysis: Aetiology, differential diagnoses, epidemiology and management. *CNS Drugs, 15*(9), 691-699.

Rolland, Y., Andrieu, S., Cantet, C., Morley, J., Thomas, D., Nourhashemi, F., et al. (2007). Wandering behavior and Alzheimer disease. The REAL.FR prospective study. *Alzheimer Disease & Associated Disorders, 21*(1), 31-38.

Rosen, G. (1958). *A history of public health.* New York: MD Publications, Inc.

Rovio, S., Kareholt, I, Helkala, E. L., Viitanen, M., Winblad, B., Tuomilehto, J., et al. (2005). Leisure time physical activity at midlife and the risk of dementia and Alzheimer's disease. *Lancet Neurology, 4(11),* 690-691.

Sacks, M. H. (1990). Eating disorders and long-distance running: The ascetic condition. *Integrative Psychiatry, 5,* 205-206.

Saegert, S., MacIntosh, E., & West, S. (1975). Two studies of crowding in urban public spaces. *Environment and Behavior, 1,* 159-184.

Schlapman, N. (1995). Testing the theory of planned behavior in a sample of mall walkers. (Doctoral dissertation, University of Wisconsin, 1995). *Dissertation Abstracts International, 56,* 2564.

Scholz, J., McGraw, K., & Steenbergen, M. (1992). Will taxpayers ever like taxes? Responses to the U. S. Tax Reform Act of 1986. *Journal of Economic Psychology, 13*(4), 625-656.

Shanteau, J., & Dino, G. (1993). *Environmental stressor effects on creativity and decision making*. New York, NY, US: Plenum Press.

Shroyer, J.L. (1994). Recommendations for environmental design research correlating falls and the physical environment. *Experimental Aging Research, 20(4),* 303-309.

Sorensen, J., Skovgaard, T., & Puggaard, L. (2006). Exercise on prescription in general practice: A systematic review. *Scandinavian Journal of Primary Health Care, 24*(2), 69-74.

Staub, R. O. (2002). *Health Psychology.* New York: Worth.

Sutton, S. B. (1971). *Civilizing American cities: A selection of Frederick Law Olmsted's writings on city landscapes.* Boston: The Massachusetts Institute of Technology.

Szlemko, W. J. Benfield, J. A., Bell, P. A., Thomas, J. J., & Tompkins, S. A. (in review). *Predictors and consequences of utilitarian physical activity among college students.*

Tavasoli, S., Heidarnazhad, H., Kazemnejad, A., & Miri, S. (2005). Association between asthma severity and obesity in two asthma clinics in Tehran. *Iranian Journal of Allergy and Asthma Immunology, 4(4),* 179-183.

Taylor, B. (2000). On fixing stress from the inside out. *Australian Journal of Holistic Nursing, 7(1), 3-10.*

Taylor, A., Doust, J., & Webborn, N. (1998). Randomised controlled trial to examine the effects of a GP exercise referral programme in Hailsham, East Sussex, on modifiable coronary heart disease risk factors. *Journal of Epidemiology & Community Health, 52*(9), 595-601.

Thayer, R., Newman, J., & McClain, T. (1994). Self-regulation of mood: Strategies for changing a bad mood, raising energy, and reducing tension. *Journal of Personality and Social Psychology, 67*(5), 910-925.

Thogersen-Ntoumani, C., & Ntoumanis, N. (2006). The role of self-determined motivation in the understanding of exercise-related behaviours, cognitions and physical self-evaluations. *Journal of Sports Sciences, 24*(4), 393-404.

Thomas, H. (2006). Obesity prevention programs for children and youth: Why are their results so modest? *Health Education Research, 21(6),* 783-795.

Thorpe, K. E., Florence, C. S., Howard, D. H., & Joski, P. (2004). The impact of obesity on rising medical spending. *Health Affairs,* July-December Web Supplement, 480-486.

Tian, J., & Wang, X. (2005). Short Communication: An epidemiological survey of job stress and health in four occupational populations in Fuzhou city of China. *Stress and Health: Journal of the International Society for the Investigation of Stress, 21*(2), 107-112.

Tudor-Locke, C., & Chan, C. (2006). An exploratory analysis of adherence patterns and program completion of a pedometer-based physical activity intervention. *Journal of Physical Activity & Health, 3*(2), 210-220.

van der Bij, A., Laurant, M., & Wensing, M. (2002). Effectiveness of physical activity interventions for older adults. *American Journal of Preventive Medicine, 22*(2), 120-133.

Webb, O., & Eves, F. (2005). Promoting stair use: Single versus multiple stair-riser messages. *American Journal of Public Health, 95*(9), 1543-1544.

Wee, C. C., Phillips, R. S., Legedza, A. T., Davis, R. B., Soukup, J. R., Colditz, G. A. et al. (2005). Health care expenditures associated with overweight and obesity among U.S. adults: Importance of age and race. *American Journal of Public Health,* 95(1), 159-165.

Weinberg, R. S., & Gould, D. (2003). *Foundations of sport and exercise psychology* (3rd ed.). Champaign, IL: Human Kinetics.

Wilcox, P., Quisenberry, N. & Jones, S. (2003). The built environment and community crime risk interpretation. *Journal of Research in Crime and Delinquency, 40(3),* 322-345.

Yamada, M., Kasagi, F., Sasaki, H., Masunari, N., Mimori, Y., & Suzuki, G. (2003). Association between dementia and midlife risk factors: The Radiation Effects Research Foundation Adult Health Study. *Journal of the American Geriatrics Society, 51*(3), 410-414.

Zimring, C., Joseph, A., Nicoll, G. L. & Tsepas, N. (2005). Influences of building design and site design on physical activity: Research and intervention opportunities. *American Journal of Preventive Medicine,* 28, 186-193.

Appendix A

Modified Minnesota Twin City Walking Survey

(Items in italics were used in final subscales)

Answer the following questions as best as you are able using the scale provided below.

1 = Strongly Disagree	2 = Disagree	3 = Slightly Disagree
4 = Slightly Agree	5 = Agree	6 Strongly Agree

Proximity

1. I can do most of my grocery shopping at local stores (within 1 mile).
2. *There are grocery stores within easy walking distance of my home.*
3. I can do most of my other shopping (clothes, movies, etc.) at local stores (within 1 mile).
4. *There are shopping areas within easy walking distance of my home.*
5. Parking is difficult in local shopping areas.
6. *There are many places to go within easy walking distance of my home.*
7. *It is easy to walk to a transit stop (e.g. bus) from my home.*
8. The streets in my neighborhood are hilly, making my neighborhood difficult to walk in.

Street Connectivity

1. The streets in my neighborhood have many dead end streets.
2. *There are many walkways in my neighborhood that connect streets to trails or other streets.*
3. *The distance between intersections in my neighborhood is usually short (100 yards or less).*
4. *There are many 4-way intersections in my neighborhood.*
5. *There are many alternative routes for getting from place to place in my neighborhood. (I don't have to go the same way every time).*

6. When walking I often cut across grassy areas to shorten my trip.
7. *It is easy to get from one place to another in my neighborhood.*
8. There are many 3-way intersections in my neighborhood.

Land Use Mix

1. *There are shopping areas near where I live (5 minute walk or less).*
2. *There are restaurants near where I live (5 minute walk or less).*
3. *In my neighborhood there is a clear distinction between residences and businesses.*
4. I have to cross a street to reach the nearest shopping area.
5. I have to cross a street to reach the nearest restaurant.

Safety from Traffic

1. There is so much traffic along the street I live on that it makes it difficult or unpleasant to walk in my neighborhood.
2. There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in my neighborhood.
3. The speed of traffic on the street I live on is usually slow (30 mph or less).
4. *The speed of traffic on most nearby streets is usually slow (30 mph or less).*
5. Most drivers exceed the posted speed limits while driving in my neighborhood.
6. There are crosswalks and walk/don't walk signals to help cross busy streets in my neighborhood.
7. The crosswalks in my neighborhood help walkers feel safe while crossing busy streets.
8. When walking in my neighborhood there are a lot of exhaust fumes (from cars, buses).
9. *Drivers allow people who are walking/biking to have the right of way.*
10. *Drivers in my area usually notice people who are walking/biking alongside the road.*
11. *Drivers in my area usually notice people who are using crosswalks.*

12. In my area, there are lots of accidents involving drivers and people walking/biking.

Safety from Crime

1. My neighborhood streets are well lit at night.
2. Walkers and bikers on the streets in my neighborhood can be easily seen by people in their homes.
3. I see and speak to other people when I am walking in my neighborhood.
4. *There is a high crime rate in my neighborhood.*
5. *The crime rate in my neighborhood makes it unsafe to go on walks during the day.*
6. *The crime rate in my neighborhood makes it unsafe to on walks at night.*

Appendix B – Perceptions of Descriptive Norms

Perceived Percent Use

1. What percent of males who live in your residence hall regularly walk/bike to class?
2. What percent of females who live in your residence hall regularly walk/bike to class?
3. What percent of males who live on-campus regularly walk/bike to class?
4. What percent of females who live on-campus regularly walk/bike to class?
5. What percent of males who live off-campus regularly walk/bike to class?
6. What percent of females who live off-campus regularly walk/bike to class?

Descriptive Norm

Answer the following questions as best as you are able using the scale provided below.

1 = Strongly Disagree	2 = Disagree	3 = Slightly Disagree
4 = Slightly Agree	5 = Agree	6 Strongly Agree

1. Most men who live in my residence hall usually walk/bike to class.
2. Most women who live in my residence hall usually walk/bike to class.
3. Most men who live on-campus usually walk/bike to class.
4. Most women who live on-campus usually walk/bike to class.

5. Most men who live on-campus walk/bike to places off-campus such as restaurants.

6. Most women who live on-campus walk/bike to places off-campus such as restaurants.

7. My best friends who live on-campus usually walk/bike to class.

8. Most of my friends who live on-campus walk/bike to places off-campus such as restaurants.

9. My best friends walk/bike to class more often than they drive or get a ride to class.

10. Most men who live in my residence hall use the elevator more than the stairs.

11. Most women who live in my residence hall use the elevator more than the stairs.

12. Most men who live on-campus use the elevator more than the stairs.

13. Most women who live on-campus use the elevator more than the stairs.

14. My best friends who live on-campus use the elevator more than the stairs.

15. There are lots of bike racks near where I live.

16. The bike racks near where I live are usually full.

17. It is easy to find space for a bike in the bike racks where I live.

18. There are lots of bike racks near where I have classes.

19. The bike racks near where I have classes are usually full.

20. It is easy to find space for a bike in the bike racks near where I have classes.

21. I usually see lots of people walking/biking to classes from the residence halls.

22. I usually see lots of people walking/biking to classes from off-campus.

23. It is easy to walk/bike to class from where I live.

24. There are lots of walking/biking paths on campus.

25. The walking/biking paths on campus get lots of use.

26. More people walk/bike to class than drive.

27. There are separate bike lanes on-campus.

28. There are separate bike lanes on roads near where I live.

Appendix C – Perceptions of Injunctive Norms

1. Most men who live in my residence hall believe that people should walk/bike to class instead of driving or getting a ride.

2. Most women who live in my residence hall believe that people should walk/bike to class instead of driving or getting a ride.

3. Most men who live on-campus believe that people should walk/bike to class instead of driving or getting a ride.

4. Most women who live on-campus believe that people should walk/bike to class instead of driving or getting a ride.

5. Most men who live on-campus believe that people should walk/bike to the store or restaurant instead of driving or getting a ride.

6. Most women who live off-campus believe that people should walk/bike to the store or restaurant instead of driving or getting a ride.

7. My best friends who live on-campus believe that people should walk/bike to class instead of driving or getting a ride.

8. My best friends who live off-campus believe that people should walk/bike to the store or restaurant instead of driving or getting a ride.

9. Most men who live on-campus believe that people should take the stairs instead of the elevator.

10. Most women who live on-campus believe that people should take the stairs instead of the elevator.

11. Most men who live in my residence hall believe that people should take the stairs instead of the elevator.

12. Most women who live in my residence hall believe that people should take the stairs instead of the elevator.

13. Most men who live off-campus believe that people should take the stairs instead of the elevator.

14. Most women who live off-campus believe that people should take the stairs instead of the elevator.

15. My best friends who live on-campus believe that people should take the stairs instead of the elevator.

16. My best friends who live off-campus believe that people should take the stairs instead of the elevator.

Appendix D – Self UPA

Answer the following questions while thinking about all of the daily activities such as going to class, going to lunch, going to the store returning to the dorms, etc. that you did in the **Past 7 days.**

On Monday did you **Walk**
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____
☐ Walk up stairsHow many total flights of stairs did you climb? _____
☐ Walk down stairs How many total flights of stairs did you climb? _____
Did you **Bike**
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____

On Tuesday did you
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____
☐ Walk up stairsHow many total flights of stairs did you climb? _____
☐ Walk down stairs How many total flights of stairs did you climb? _____
Did you **Bike**
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____

On Wednesday did you
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____
☐ Walk up stairsHow many total flights of stairs did you climb? _____
☐ Walk down stairs How many total flights of stairs did you climb? _____
Did you **Bike**
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____

On Thursday did you
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____
☐ Walk up stairsHow many total flights of stairs did you climb? _____
☐ Walk down stairs How many total flights of stairs did you climb? _____
Did you **Bike**
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____

On Friday did you
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____
☐ Walk up stairsHow many total flights of stairs did you climb? _____
☐ Walk down stairs How many total flights of stairs did you climb? _____
Did you **Bike**
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____

On Saturday did you
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____
☐ Walk up stairsHow many total flights of stairs did you climb? _____
☐ Walk down stairs How many total flights of stairs did you climb? _____
Did you **Bike**
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____

On Sunday did you
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____
☐ Walk up stairsHow many total flights of stairs did you climb? _____
☐ Walk down stairs How many total flights of stairs did you climb? _____
Did you **Bike**
☐ To class How many total minutes? _____ How many trips did you make? _____
☐ Home How many total minutes? _____ How many trips did you make? _____
☐ Between classes How many total minutes? _____ How many trips did you make? _____

Appendix E – Peer UPA

Answer the following questions while thinking about all of the daily activities, such as going to class, going to lunch, going to the store returning to the dorms, etc. that your friends did in the **Past 7 days.** Please use your best estimate of what you think your friends did.

On Monday did your friends **Walk**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____
☐ Walk up stairsHow many total flights of stairs did they climb? _____
☐ Walk down stairs How many total flights of stairs did they climb? _____
Did your friends **Bike**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____

On Tuesday did your friends **Walk**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____
☐ Walk up stairsHow many total flights of stairs did they climb? _____
☐ Walk down stairs How many total flights of stairs did they climb? _____
Did your friends **Bike**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____

On Wednesday did your friends **Walk**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____
☐ Walk up stairsHow many total flights of stairs did they climb? _____
☐ Walk down stairs How many total flights of stairs did they climb? _____
Did your friends **Bike**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____

On Thursday did your friends **Walk**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____
☐ Walk up stairsHow many total flights of stairs did they climb? _____
☐ Walk down stairs How many total flights of stairs did they climb? _____
Did your friends **Bike**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____

On Friday did your friends **Walk**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____
☐ Walk up stairsHow many total flights of stairs did they climb? _____
☐ Walk down stairs How many total flights of stairs did they climb? _____
Did your friends **Bike**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____

On Saturday did your friends **Walk**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____
☐ Walk up stairsHow many total flights of stairs did they climb? _____
☐ Walk down stairs How many total flights of stairs did they climb? _____
Did your friends **Bike**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____

On Sunday did your friends **Walk**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____
☐ Walk up stairsHow many total flights of stairs did they climb? _____
☐ Walk down stairs How many total flights of stairs did they climb? _____
Did your friends **Bike**
☐ To class How many total minutes? _____ How many trips did they make? _____
☐ Home How many total minutes? _____ How many trips did they make? _____
☐ Between classes How many total minutes? _____ How many trips did they make? _____

Appendix F – Demographics

1. What is your gender? Female Male

2. How old are you? _________

3. What is your Ethnicity? ______________

4. How tall are you? ___________

5. What is your current weight? __________

6. Did you play sports in high school? No Yes

7. In high school what method of transportation did you usually use to get to school?

____

8. In high school what method of transportation did you usually use to get home from school? __

9. Do you live: on-campus off-campus

a). If you live on-campus, in which residence hall do you live? _____________

b). If you live off-campus, what is the nearest intersection to your residence?

______

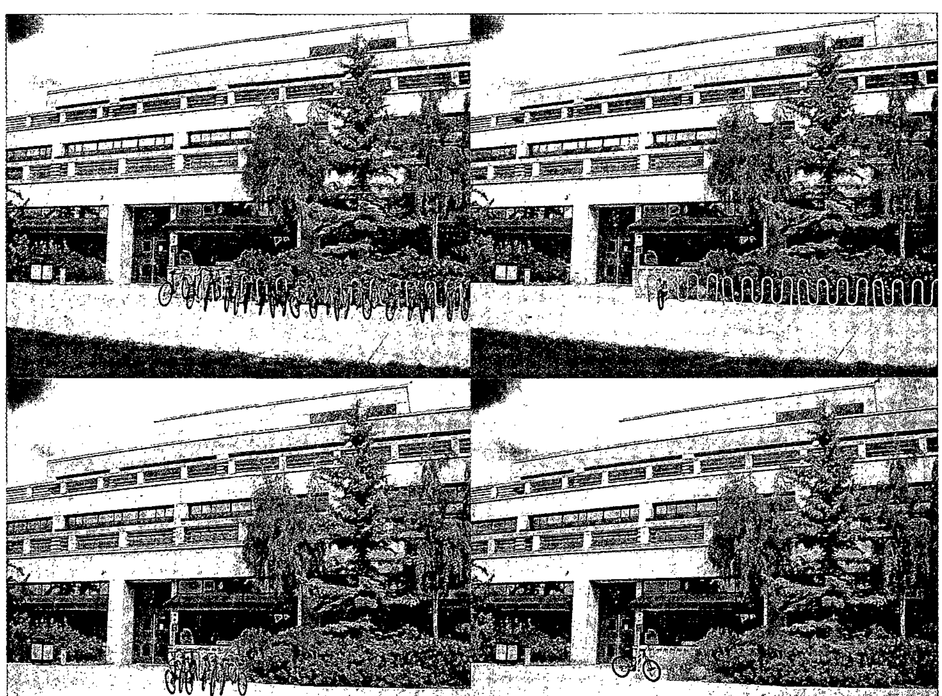
10. What floor do you live on?

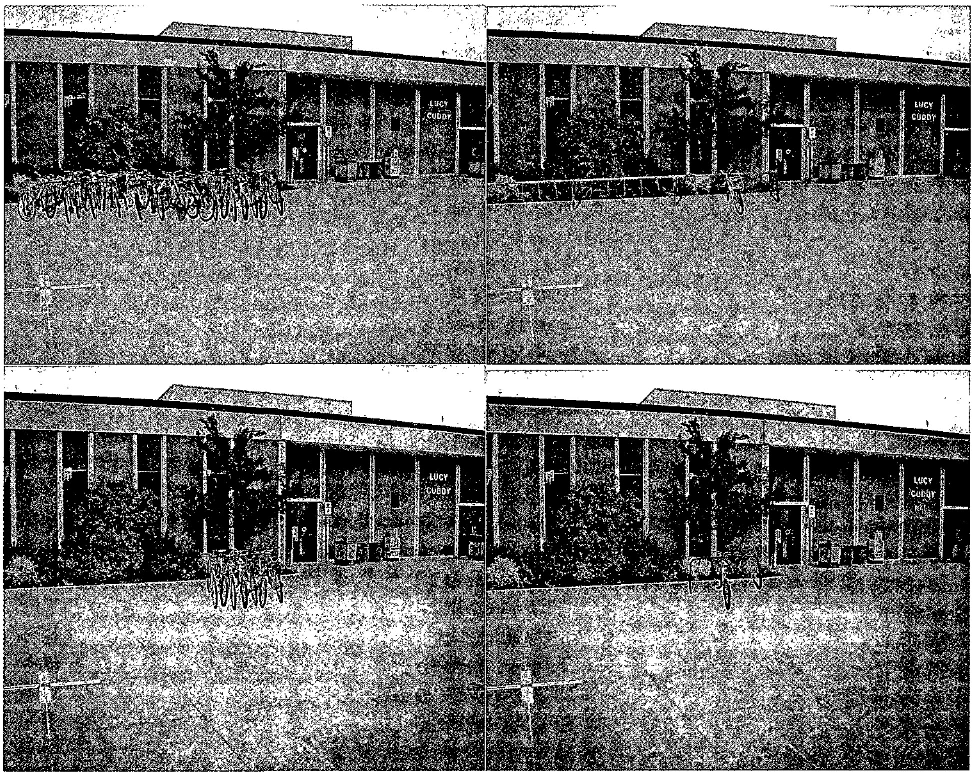
Basement Ground 2^{nd} 3^{rd} 4^{th} 5^{th} 6^{th} 7^{th} 8^{th}

9^{th} 10^{th} 11^{th} 12^{th} 13^{th} 14^{th} 15^{th}

11. Where did you grow up (City, State, Zip Code)? __________

Appendix G – Stimulus Materials




LUCY
CUDDY

Appendix H – Evaluation Questions

Use the scales provided to answer the following questions while considering the photograph shown above. There are no right or wrong answers, we are simply interested in your opinion.

1 = strongly disagree 2 = disagree 3 = slightly disagree

4 = slightly agree 5 = agree 6 = strongly agree

1. I would feel safe from crime in the area shown during the day.
2. I would feel safe from crime in the area shown during the night.
3. The lighting in this area would be adequate during the night.
4. I would feel safe from traffic in the area shown.
5. It would be easy to walk where I want to go in this area.
6. It would be easy to bike where I want to go in this area.
7. The sidewalks are in good condition in the area shown.
8. I would walk to this location if I lived 1 mile away from it.
9. I would bike to this location if I lived 1 mile away from it.
10. My friends would walk to this location if they lived 1 mile away from it.
11. My friends would bike to this location if they lived 1 mile away from it.
12. A high percentage of people in the area walk to this location.
13. A high percentage of people in the area bike to this location.
14. This location is aesthetically pleasing.

15. I feel that I could easily relax in the area shown.

16. The location shown is peaceful.

17. People who live in this area value their health.

18. People who live in this area value being physically active.

19. I would enjoy going to school on this campus.

20. The people who go to school on this campus are probably not very nice.

21. It is very likely that I would walk or bike to my classes if I went to school here.

22. Something about this location makes me feel uneasy.

23. There is probably a lot of crime in this area.

24. There is probably a lot of traffic in this area.

25. There should be more trees on this campus.

26. The grounds are well maintained on this campus.

27. This campus has a litter problem.

28. Most students on this campus recycle regularly.

29. What percent of the *(number)* of people who go to this school walk to class regularly?___

30. What percent of the *(number)* of people who go to this school bike to class regularly? ___