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Effects of environmental prompts on stair usage

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EFFECTS OF ENVIRONMENTAL PROMPTS ON STAIR USAGE

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ABSTRACT

The Effects of Environmental Prompts on Stair Usage

by

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The objective of this study was to evaluate whether environmental prompts placed in two-story buildings on a university campus would increase stair usage. Three buildings were used. One served as a control, while the other two received an intervention. Participants of three buildings were observed taking the stairs and elevator for seven weeks. Baseline data was collected; signs were introduced, and then removed during this time period. Approximately 2700 observations were collected. Environmental prompts did not appear to increase stair usage. There were significant differences in the amount of stair users between buildings. The stair usage rates of this particular study were quite high compared to other studies. A ceiling effect may have contributed to the lack of significant change in stair usage. The built environment may also have been a contributor to the differences in stair usage rates between buildings.

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INTRODUCTION

Statement of the Problem

Physical inactivity is a prevalent problem within the United States (U.S. Department of Health and Human Services [USDHHS], 1996). For many years experts have tried to combat physical inactivity but haven't succeeded. The increasing rates of obesity, cardiovascular disease, certain types of cancer, diabetes, and other issues related to physical inactivity suggest that many Americans are not receiving the benefits of physical activity. Obesity in the United States has been on the rise and is at an all-time high. In 1991, only four states reported having obesity rates between 15% and 19%. By 2008, the number of states reporting obesity rates between 15% and 19% was only one, but 17 states reported obesity rates between 20% and 24%, 26 reported rates between 25% and 29%, and six states reported obesity rates over 30% (Centers for Disease Control and Prevention [CDC], 2009). These figures are stunning considering the negative health effects of obesity.

USDHHS (1996) has found that low levels of physical activity are among the main contributors to the high prevalence of obesity in the United States. Physical activity can positively affect the body fat distribution within the body. In 2001, the Surgeon General issued a call to action to prevent and decrease the rise in overweight and obese individuals. This report stated that physical activity is critical in maintaining weight loss, preventing weight gain, and treating overweight and obesity (USDHHS, 2001).

To encourage a physically active lifestyle, experts have recommended simple ways to increase physical activity, such as taking the stairs instead of the elevator or escalator. This is a quick and easy way to add physical activity into one's daily routine (CDC, 2007). Much research has been conducted about ways to increase stair usage. Several studies suggest that adding an environmental prompt at the point of decision between the stairs and the elevator or escalator can increase stair usage (Andersen, Franckowiak, Snyder, Bartlett, & Fontaine, 2005; Bungum, Meacham, & Truax, 2007; Eves, Webb, & Mutrie, 2006; Ford & Torok, 2008; Kerr, Eves, & Carroll, 2000; Kerr, Eves, & Carroll, 2001a; Kerr, Eves, & Carroll, 2001b; Kerr, Eves, & Carroll, 2001c; Russell, Dzewaltowksi, & Ryan, 1999; Russell & Hutchinson, 2000; Webb & Eves, 2005; Webb & Eves, 2007). The research has demonstrated that point-of-decision prompt messages are unique in the manner they motivate people to use the stairs. For example, Webb and Eves (2007) conducted interviews about environmental prompts and which specific phrases would encourage stair usage. Participants suggested that specific consequence environmental prompts were more likely to motivate them to use the stairs. The researchers concluded that the phrase "Exercise Your Heart" may not be an effective message for a younger population because of their lack of concern for heart health (Webb & Eves, 2007).

Purpose

The purpose of this study is to examine how specific messages impact the use of stairs over the elevator. Two signs were used. One made the general statement, "Get Fit, Take the Stairs," while another was more specific about the number of calories burned while taking the stairs, "Burn One Calorie for Every Six Stairs." Each sign contained a graphic. Examples of the signs used can be found in Appendix A and B. These phrases were chosen based on recommendations from literature (Webb & Eves, 2007).

Research Questions

The questions that form the basis of this study are:

- Do environmental prompts placed at a point of decision in a two-story building at a Southwestern university increase stair usage?
- If so, does a sign addressing caloric expenditure increase stair usage more or less than a sign with a general health phrase?

Significance

This study aims to generate knowledge about the effects of environmental prompts on stair usage. Learning more about these effects will provide additional insight into effective and relatively inexpensive types of environmental prompts that are linked to increased stair usage. This can help others to identify which phrases are most effective and in turn generate better results and potentially increase physical activity.

Hill, Wyatt, Reed, and Peters (2003) have discussed the idea of an energy gap. They define an energy gap as the “required change in energy expenditure relative to energy intake necessary to restore energy balance” (pg. 854). In other words, this means how much of an increase in caloric expenditure or decrease in caloric intake is necessary to stop weight gain in the adult population. Using data from the National Health and Nutrition Examination Survey [NHANES] and the Coronary Artery Risk Development in Young Adults [CARDIA], the researchers identified the average weight gain in the population to be approximately 1.8 to 2.0 pounds per year. An average person would consume an extra 6500 to 7000 calories a year to put on that weight, or an estimated energy accumulation of 15 calories a day. This suggests that the daily energy accumulation is relatively small and can be expended through an increase in simple physical activity, such as taking the stairs (Hill, Wyatt, Reed & Peters, 2003).

There are many benefits to stair climbing. Stair climbing can reduce levels of cholesterol and body fat and increase muscle strength (Boreham, Wallace, & Nevill, 2000; Ilmarien, 1974; Loy et al., 1994; Teh & Aziz, 2000). Because stair climbing is a weight bearing exercise, it can assist in maintaining skeletal health (Haskell et al., 2007). Stair climbing also meets the guidelines for achieving cardiovascular fitness (Teh & Aziz, 2002). Possibly two of the most attractive options about stair climbing are its low in cost and convenient (Teh & Aziz, 2002).

Hypotheses

Null Hypothesis: Different signs will not have different results in increasing stair usage.

Alternative Hypothesis: Different signs will have different results in increasing stair usage.

Null Hypothesis: Specific signs will not yield a higher result in increasing stair usage.

Alternative Hypothesis: Specific signs will yield a higher result in increasing stair usage.

Null Hypothesis: Males and females will not significantly differ in stair usage.

Alternative Hypothesis: Males and females will significantly differ in stair usage.

Definitions

Physical activity: According to the Physical Activity Guidelines for Americans (USDHHS, 2008), physical activity is, “Any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level. In these guidelines, physical activity generally refers to the subset of physical activity that enhances health” (pg. 53).

Exercise: Caspersen, Powell, & Christenson (1985) define exercise as planned, structured, repetitive movements of the body aimed at increasing one of the main components of physical fitness.

Point-of-decision prompt: An intervention which alters the physical or built environment that influences one to be physically active versus sedentary (Russell, Dzewaltowski, & Ryan, 1999). Point-of-decision prompts are typically placed in an area where one will be making a choice. In this study, point-of-decision prompts were signs encouraging stair usage and were placed where one would be deciding to take the stairs or the elevator.

CHAPTER 2

REVIEW OF LITERATURE

Physical Activity

Physical activity has been recognized as a vital part living. The Centers for Disease Control and Prevention (December 3, 2008) states that physical activity is "one of the most important things you can do for your health." Some of the benefits of being physically active include weight control, stronger bones and muscles, improved mood, decreased feelings of depression and anxiety, reduced risk for cardiovascular disease, lower cholesterol and blood pressure, reduced risk for metabolic syndrome, reduced risk for Type 2 diabetes, reduced risk for certain types of cancer (including breast and colon), increased chance of living longer, and improved overall quality of life (CDC, 2008; USDHHS, 1996). Equally important, the physically inactive put themselves at an increased risk for morbidity and mortality (USDHHS, 1996). Those who are physically active are also absent from work fewer days (Hill & Peters, 1998).

Recommendations for physical activity to maintain health have been defined by the American College of Sports Medicine [ACSM] and were recently revised. The new guidelines state that healthy adults ages 18-64 should participate in 30 minutes of moderate intensity exercise most days of the week or 20 minutes of vigorously intense exercise a minimum of three days a week. The recommendations also state that a combination of moderate and vigorous exercise can bring health benefit (Haskell et al., 2007). The specific recommendations are:

> Adults should do a minimum of 2 hours and 30 minutes of moderate-intensity aerobic activity a week by doing activities like brisk walking, ballroom dancing, or general gardening. Adults can choose 1 hour and 15 minutes (75 minutes) a week of vigorous-intensity aerobic physical activity by doing exercise like jogging, aerobic dancing, and jumping rope. Adults also may choose combinations of moderate- and vigorous-intensity aerobic activity.
>
> Aerobic activity should be performed in episodes of at least 10 minutes, and preferably spread throughout the week. For additional and more extensive health benefits, adults should increase their aerobic physical activity to 5 hours (300 minutes) a week of moderate-intensity or 2 hours and 30 minutes a week of vigorous-intensity aerobic physical activity or an equivalent combination of moderate- and vigorous-intensity activity. Additional health benefits are gained by engaging in physical activity beyond this amount (USDHHS, 2008, pg 1083).

Despite the benefits achieved through physical activity, many people remain inactive. This is a major public health concern. According to the USDHHS (1996), physical inactivity carries a large financial burden of illness and premature death to society. Research has shown that most Americans do not meet the recommendations for physical activity, and many are considered completely inactive (Jones et al., 1998). Data on those who meet recommendations for moderate leisure-time physical activity comes from a cross-sectional survey, the National Health Interview Survey [NHIS], which was conducted in 1990. Though this is older data, it provides an indicator of the percentage of physically active Americans. Survey data indicate that 32% of Americans met the CDC-ACSM physical activity recommendations. This means that over 60% of Americans were not meeting the recommendations. Data indicated men were more physically active than women, but this could be the result of a lack of questions related to physical activity associated with child care and household work. Still, this survey shows that there is much room for improvement in the number of Americans who are physically active (Jones et al., 1998). Similarly, the USDHHS (1996) reported that one in three adults report no leisure time physical activity. Recently, the CDC used data from the Behavioral Risk Factor Surveillance System [BRFSS] in 2007 to determine the number of Americans who are meeting the revised recommendations. Researchers identified approximately 35% of Americans were not meeting the recommendations for physical activity (CDC, 2008).

Despite the fact that many Americans are still not meeting the current recommendations, Strum (2004) has hypothesized there has been a median increase of physical activity by 20 minutes a week from 1990 to 2000. This demonstrates that Americans' participation in physical activity may be improving. Strum (2004) described how in the past 40 years, most major changes in how Americans spend their time are seen in leisure. It is estimated that Americans have four more hours a week of leisure time than in 1965. Though leisure time has increased, there has also been a drastic rise in obesity. These messages seem counterintuitive. If Americans have more time, why has there not been a significant increase in physical activity, or a decrease in obesity? Strum (2004) has examined Gross Domestic Product [GDP] to see if monetary purchases explained any of the leisure-time activity changes. Purchase of sporting goods and bicycles increased slightly from 1987 to 2001, but radio and television store purchases increased drastically in the same time period. Sports club memberships also saw small increases, but spectator sports saw a five-fold increase. Those activities associated with moderate or vigorous physical activity grew more slowly than those connected to a sedentary lifestyle. Leisure-time has increased; yet, physical activity has not increased to meet the recommended amount of physical activity.

Physical Inactivity Intervention

Individual behavior change modification has been effective at increasing physical activity, but the sky-rocketing obesity rates call for other interventions as well (Kahn et al., 2002). Sallis, Bauman, and Pratt (1998) state that interventions targeting physical activity must be done on a population scale, because individual interventions will not bring the necessary change for the entire population. These authors suggest the most effective ways of accomplishing this goal are through environmental and policy interventions.

Health promotion specialists have used policy change and environmental intervention as a way to increase quality of life, but for whatever reason, the application in the physical activity domain is little used. Accordingly, Sallis, Bauman, and Pratt (1998) described the constructed environment as a barrier to physical activity. The defined constructed environment, also referred to as the built environment, includes buildings, stairwells, elevators, escalators, and their relationship to each other. The authors (1998) suggest interventions can be used as a way to overcome imposed barriers. Because it would be unreasonable to intervene by reconstructing a building, environmental prompts could possibly be an effective tool for increasing physical activity inside a building. The research on environmental prompts will be discussed further in the literature review.

Other ways of increasing physical activity would be increasing the number of Activities of Daily Living or hybrid physical activity as a way of incorporating physical activity into normal routines. Zemring, Joseph, Nicoll, and Tsepas (2005) define hybrid physical activity as an instance where health and fitness do not serve as the primary goal, but a secondary motive or added bonus. An example of hybrid physical activity is if an individual drives to the store and parks the car farther away in the lot or an employee uses the stairs instead of the elevator. This is also known as utilitarian physical activity (Ewing, Schmidt, Killingsworth, Zlot, & Raudenbush, 2003).

The work environment has also contributed to the decline in physical activity. In past decades, work had been associated with physical activity through labor. Strum (2004) states technological changes have made work less strenuous and less energy intensive. Technological advances have decreased the need to be physically active at work. Though the current work environment doesn't often support physical activity, employees can find ways to incorporate physical activity into their daily routine. Taking the stairs is an example of a physical activity that can be included into the daily routine. Not only is taking the stairs during the work day a good way for employees to be physically active, Russell and Hutchinson (2000) state that it is an easy way for sedentary people to become more physically active.

Environmental interventions are a prime market to encourage stair usage. Russell and Hutchinson (2000) state point-of-decision prompts are successful because they are designed to decrease the access and attractiveness of the sedentary option of taking the elevator or escalator.

Webb and Eves (2007) state that the socio-ecological model recognizes that environment has an impact on physical activity. Foster, Hillsdon, and Thorogood (2004) refer to the potential ability of the environment to impact physical activity as physical activity that enhances health. This is crucial, considering many Americans are not achieving health benefits through exercise. Environmental change could positively impact this.

Benefits of Stair Climbing

Stair climbing has myriad health benefits (Eves, Webb, & Mutrie, 2006). Stair climbing can improve cardiovascular health, reduce levels of cholesterol and body fat, and increase strength in the legs (Boreham, Wallace, & Nevill, 2000; Ilmarinen et al., 1979; Loy et al., 1993; Teh & Aziz, 2002). Haskell et al. (2007) also maintain that skeletal health can be achieved through weight-bearing activity, like stair climbing. Other reasons stair climbing is an attractive physical activity option for the public is because it is low in cost, convenient, and requires no extra equipment (Teh & Aziz, 2002). Teh and Aziz (2002) found that the average maximal oxygen consumption and heart rates for stair ascension clearly meet the American College of Sports Medicine guidelines for achieving cardio respiratory fitness; though these benefits are not achieved in stair descent. Stair descent uses approximately one-third the energy expenditure of stair ascending (Bassett, et al., 1997).

Though stair climbing has multiple health benefits, the caloric expenditure of stair climbing is not significant. Still, stair climbing burns more calories than merely standing in an elevator (Eves, Webb, & Mutrie, 2006). Teh and Aziz (2002) calculated the gross caloric cost of stair climbing and descent for each stair was 0.16 kilocalories per step. This is about 1 kilocalorie for every 6 steps ascended and descended and was used as the basis for the creation of one of the environmental prompts used during data collection. This calculation did not include the energy expenditure for the steps taken on the landing from stair to stair. However, these calculations are highly dependent on the body weight and speed of climbing. Individuals who are heavier would find stair climbing more physically laborious and would burn more calories than lighter people.

Setting

As previously discussed, environmental interventions may be effective in encouraging physical activity in public areas. Various public settings have been used to examine the relationship of point-of-decision prompts and stair usage.

Many studies have observed escalator and stair usage in shopping centers (Kerr, Eves, & Carroll, 2001a; Kerr, Eves, & Carroll, 2001b; Kerr, Eves, & Carroll, 2001c; Kerr, Eves, & Carroll, 2000; Webb & Eves, 2005; Andersen et al., 1998). Other researchers have focused on other public areas such as airports, train stations, banks, parking garages, and worksites (Bungum, Meacham, & Truax, 2007; Eves, Webb, & Mutrie, 2006; Kerr, Eves, & Carroll, 2001a; Russell & Hutchinson, 2000). Relatively few studies have been conducted in a university setting. Ford and Torok (2008) were one of the few studies that have been conducted on a college setting and recommend this as a perfect intervention setting because younger adults are more liked to be shaped by behavior change mechanisms than older adults.

A gap in the research also exists among choice between stair climbing and elevator use. Bungum, Meacham, and Truax (2007), Russell, Dzewaltowski, and Ryan (1999), and Ford and Torok (2008), Eves and Webb (2006) are among the few researchers who have conducted studies examining the relationship between environmental prompts and elevator or stair usage. Trends toward increased stair usage with environmental prompts in buildings with elevators still looks like an effective mechanism for increasing physical activity and curbing the obesity issue, but could benefit from more research.

Poster Characteristics

Studies have tried to generate knowledge about the types of signs that yield the highest increase in stair usage. Researchers have experimented with size, message, and banners versus posters to determine if these increase the ratio of stair usage.

Kerr, Eves and Carroll (2001a) found that specific poster sizes increased stair usage from 3.0% to 3.9% for an A2 poster size and to 4.7% for an A1 poster size. Stair usage decreased from 3.0% to 2.9% for an A3 poster size. An A1 poster is approximately 23 inches by 33 inches; an A2 poster is approximately 16.5 inches by 23 inches; an A3 is approximately 11.5 inches by 16.5 inches. Other research varied on poster size but still yielded favorable results for effective stair climbing increases (Andersen, Franckowiak, Snyder, Bartlett, & Fontaine, 1998; Bungum, Meacham & Truax, 2007; Ford & Torok, 2008; Russell, Dzewaltowski & Ryan, 1999; Russell & Hutchinson, 2000).

Some research has examined the relationship between posters and banners. Webb and Eves (2007) gathered baseline data of stair users at 7% and saw an increase to 14.2% after the introduction of their intervention using banners. Kerr, Eves, and Carroll (2001c) also saw increases in stair usage after introducing banners as their intervention from 8.1% to 18.4% percent. Kerr, Eves, and Carroll (2001c) found that banners on stair risers are more effective than posters are at point of choice, in situations where escalators and stairs are adjacent to each other. This allows multiple messages to be sent and appeal to a variety of people. Kerr, Eves and Carroll (2001c) wrote they believe the banners were more effective than posters because of the multiple messages they were able to send, their visibility from a greater distance, and the way they improved the aesthetics of the stairs.

Many messages have been used during stair climbing research. The content has addressed fitness level, cost of exercise, lifestyle, limited time, ease of exercise, weight control, and improvement of heart function and blood pressure, as well as messages that have encourage people to leave the elevators for physically challenged and staff members. Webb and Eves (2007) recommend specificity in poster prompts. These authors compared general description messages to specific messages on poster prompts. They found that participants rated poster prompts with specific consequences as more likely to succeed at encouraging stair usage. Webb and Eves (2007) also found the phrase "Exercise Your Heart" is effective for older populations, but not typically effective for younger populations. Younger populations respond better to signs geared toward weight management. This is why the development of a sign addressing caloric expenditure was used in this study.

Andersen, Franckowiak, Snyder, Bartlett, and Fontaine (1998) have also concluded that signs focusing on weight control may be more beneficial than other types of signage. Baseline data was recorded at 4.8% and increased to 7.2% after an intervention focusing on weight control, versus 6.9% after an intervention focusing on health benefits.

Russell and Hutchinson (2000) contributed to knowledge about sign content. These researchers used a health promotion sign and a deterrent sign. The health promotion sign stated, "Save time, keep your heart healthy, use the stairs," whereas the deterrent sign read "Please limit escalator use to staff and those individuals who are unable to use the stairs." The signs increased stair usage from 8.22% to 14.98% [health promotion sign] and 14.40% [deterrent sign] respectively. Their results indicated both health promotion signs and deterrent signs are effective ways to increase stair usage. They also suggested that younger women (under 40) were most likely to use the stairs, followed by younger men, and older women. Older men were least likely to take the stairs.

Other Predictors of Stair Use

Other research conducted on predictors of stair usage is worthy to note. Bungum, Meacham and Truax (2007) suggest the number of floors in a building is a predictor of stair usage. As the number of floors increased, stair usage decreased. The thinking is that an individual is more likely to climb one flight of stairs than more. Nicoll (2007) established that spatial measures are also predictors of stair usage. The most prominent spatial measures that increase stair usage are stair width and stair type. Stair width is one of the strongest predictors of stair usage, because people travelling in groups are more likely to remain engaged in conversation while taking the stairs in wider stairwells. The CDC also determined aesthetic features can increase stair usage. In a study conducted at the CDC Rhodes building in Atlanta, new carpeting was installed, walls were painted, framed artwork was added to stair landings, motivational signs were displayed, and music was played in the stairwell. Results indicated an increase in stair usage and that physical improvements to stairwells may increase physical activity (CDC, 2004).

CHAPTER 3

METHODS

Experimental Design

In this quasi-experimental study, stair and elevator use were monitored. One building served as a control, and the other two buildings received an environmental prompt. One building was assigned a sign with the generic phrase, “Get Fit, Take the Stairs,” while the other building received a sign with the specific phrase, “Burn One Calorie for Every Six Stairs.” Because buildings and intervention signs were not randomly selected, the design of this research was quasi-experimental.

Participants were users of the stairs or elevators in the three buildings. Exclusion criteria included people using wheelchairs or crutches, those carrying or bearing large equipment, children, and people with children. IRB approval was received and can be seen in Appendix C.

Observations took place on Tuesdays and Thursday for an hour in each building. Baseline observations were collected for two weeks. After baseline data collection, specified signs were placed in the two intervention buildings, and three weeks of observation occurred. The signs were removed and a final data collection occurred for two weeks.

Location of sign placement within the building was determined by the primary researcher in consultation with building maintenance supervisors. They were located at point-of-decision areas, such as the entrance doors to the buildings and the space near the elevator. Signs were placed on the doors upon entrance to the building, at the bottom of stairs, bottom of the elevator, and top of the elevator.

Signs were created by an undergraduate student in the Department of Graphic Design at the University of Nevada, Las Vegas. Samples of signs placed can be found in Appendices A and B. Messages were created using previous research as described in the literature review. Signs were placed at the top and bottom of the elevator and upon entering the buildings. Each building received one 11 x 17 poster and the remaining posters displayed were standard 8 1/2 x 11.

Data was collected using direct observation by the researcher. The researcher was positioned in an inconspicuous area where the stairs and elevator could both be seen. When the researcher was questioned about her observations, the observer briefly explained that she is collecting data. The observer recorded data including whether the participant came up or down the stairs, used the elevator going up or down, gender, approximate age group (young: 18-30, middle: 31-50, or old: 51 or above) and presence of bags or backpacks. Recording instruments were used and can be found in Appendix D. Groups that used the stairs simultaneously were recorded individually.

Description of Buildings Used

Buildings were chosen based on the number of floors, which were limited to two. Each selected building had a point where both the stairs and elevator could be seen simultaneously. Stair height on all staircases is between six and eight inches, which is standard building code (Nicoll, 2007). Building supervisors were contacted via email and recommended buildings for research.

The Lily Fong Geoscience Building's elevator is located outside the main building on the north side. Stairs are located immediately inside the building. The stairwell has 12 steps, a landing, and then 11 more steps to the second floor. The stair area is semi-enclosed. The width of the staircase is approximately 56 inches. This building served as the control building.

The Bigelow Physics Building's elevator is located in the center area of the building, whereas two staircases are located immediately upon entrance into the building on both the north and the east side. The north stairs have 17 steps, a landing, and then 17 more steps to the second floor and the stair area is open and spacious. This staircase has a width of approximately 64 inches. The east staircase has 5 steps, a landing, 11 more steps, another landing, 11 more steps, and another landing, and 5 more steps. This staircase is dark and enclosed and has a width of 49 inches. This building received the "Get Fit, Take the Stairs" sign.

The Thomas T. Beam Engineering Complex "B" Building is characterized by stairs and elevator that are in relatively close proximity. The stairs have 19 steps, a landing, and then 19 more steps to the second floor. The stair area is open and spacious and the staircase width is 105 inches. This building received the "Burn 1 Calorie for Every Six Stairs" sign.

Statistical Analysis

The Loglinear model was used, testing for all main effects (building, age group, use of bag or backpack, gender, direction, and phase) and adjusted for all potential interaction effects using stair usage as the outcome variable. Here, the likelihood of taking the stairs versus the elevator was also modeled. A Chi-Square test for trend was used to compare individual buildings at multiple time points (pre-intervention, intervention, and post-intervention) and Chi-Square distribution was used to compare buildings across phases. Chi-Square contingency tables and risk ratios were also used to determine directionality and magnitude of difference for appropriate examples.

CHAPTER 4

RESULTS

General Results

Over the three-phase intervention, 2707 observations were recorded, and 11 observations were missing data. Of the 2696 remaining observations, 80 percent (n= 2155) were males and 20 percent (n= 544) were female. Eight observations were omitted because of missing gender data. Other demographic information can be seen below in Table 1.

Table 1

Demographics of Total Participant Population

Variable	Frequency	Percent
Gender		
Male	2155	79.6%
Female	544	20.1%
Missing	8	0.3%
Estimated Age Group		
Younger (18-30)	1910	70.6%
Middle (31-50)	723	26.7%
Older (51+)	71	2.6%
Missing	3	0.3%

Table 2

Demographics of Participant Population by Building

Building	Variable	Frequency
Geoscience	Male	119
(Control)	Female	47
	Younger (18-30)	71
	Middle (31-50)	79
	Older (51+)	16
Engineering	Male	1285
(Specific Message)	Female	258
	Younger (18-30)	1177
	Middle (31-50)	342
	Older (51+)	25
Physics	Male	751
(General Message)	Female	239
	Younger (18-30)	662
	Middle (31-50)	302
	Older (51+)	30

Overall, 86.5% (n= 2342) of total participants were observed taking the stairs versus 13.4% (n= 362) who used the elevator.

Though the number of male participants observed far outweighed the female participants observed, the Goodness of Fit Test showed adequacy and the Loglinear model converged.

Predictors of Stair Usage

Age was a statistically significant predictor of stair usage ($p < 0.001$). Table 3 represents the observed frequencies and expected frequency counts suggesting young participants were more likely to use the stairs as compared to the other two age groups. Younger and middle aged participants were more likely to use the stairs as compared to the older age category ($p<0.001$ for both groups, $z= 4.981$ for younger age group, $z= 4.368$ for middle age group). The significance of age was regardless of building.

Statistical significance was also found based on gender ($p < 0.001$, $z= 4.270$). Over 87% of males were stair users ($n= 1886$), whereas 83% of females were stair users ($n= 453$), suggesting males were slightly more likely to take the stairs than females.

Direction was also statistically significant ($p < 0.001$). Participants were more likely to take the stairs down versus up. Among stair users, 60% of the participants went down via the stairs, while 40 percent went up using the stairs.

Other Significant Results

During the intervention portion of the study, participants observed in the Physics building, which received the generic sign “Get Fit, Take the Stairs,” were not more likely to take the stairs than the control group, who were observed in the Geoscience Building ($p = 0.787$, $z = -0.271$).

Participants receiving the specific message, “Burn 1 Calorie for Every 6 Stairs,” were more likely to take the stairs compared to the general message group ($p = 0.002$, $z = -3.041$). The data suggest the tailored sign was statistically significant and more effective at increasing stair usage. Data indicated the tailored sign remained effective post-intervention, when the signs were removed, as compared to pre-intervention ($p = 0.014$).

Other findings to note include the statistical non-significant result of bag usage ($p = 0.272$, $z = -1.100$).

There were multiple significant two-way interactions, indicating changes within the participant characteristics from the various covariates. Many statistical interactions existed and can be seen in Table 3, below.

There was a statistical interaction between age and intervention ($p = 0.018$, 0.01 for young group pre-intervention and intervention; $p = 0.049$, 0.009 for middle aged group pre-intervention and intervention. This indicates there were changes in the age group categories over observation periods (pre-intervention, intervention, and post-intervention). Statistical interactions existed between the use of bag or backpack and the up direction ($p = 0.012$). There was also a significant change in the number of males who used bags and took the stairs ($p = 0.0001$).

Table 3

2 Way Interaction Effects

	Z value	p value
Young* Bag	7.087	p < 0.001
Control * Young	-5.474	p < 0.001
Control * Middle	-2.344	0.019
Young* Up	-4.056	p < 0.001
Middle* Up	-2.841	0.004
Young* Male	-3.13	0.002
Middle* Male	-3.217	0.027
Young* Pre intervention	2.376	0.018
Young* Intervention	2.582	0.01
Middle* Pre-intervention	1.967	0.049
Middle* Intervention	2.598	0.009
Building 2* Bag	7.753	p < 0.001
Bag* Up	-2.511	0.012
Bag* Male	-5.469	p < 0.001
Building 1* Up	-5.61	0.575
Building 2* Up	-4.514	p < 0.001
Building 1* Male	-2.78	0.005
Building 2* Male	6.415	p < 0.001
Building 2* Pre-intervention	2.454	0.014

Results by Building and Intervention Phase

Using Table 4 as a reference, the Chi Square test for trend was used to compare each building across multiple time points (pre-intervention, intervention, and post-intervention). Each building did not show significance (Building 1: x^2= 0.005, p= 0.946; Building 2: x^2= 0.167, p= 0.683; Building 3: x^2= 0.014, p= 0.906). Yet as seen in Figures 1 and 2, the stair use trend seems to increase with the introduction of the two signs. Still, significance was not achieved.

Table 4

Stair Use Rates by Building by Observation

	Frequency (% of stair usage)			
Observation Time	Building 1 Control	Building 2 Specific Message	Building 3 General Message	Total
Pre-intervention	44 (100)	442 (93.4)	197 (72.4)	683 (86.6)
Intervention	73 (97.3)	629 (93.6)	322 (76.1)	1024 (87.5)
Post-intervention	50 (100)	369 (89.6)	219 (73)	608 (84.7)
Total	167 (98.8)	1440 (93.3)	738 (74.2)	2354 (86.7)

Figure 1

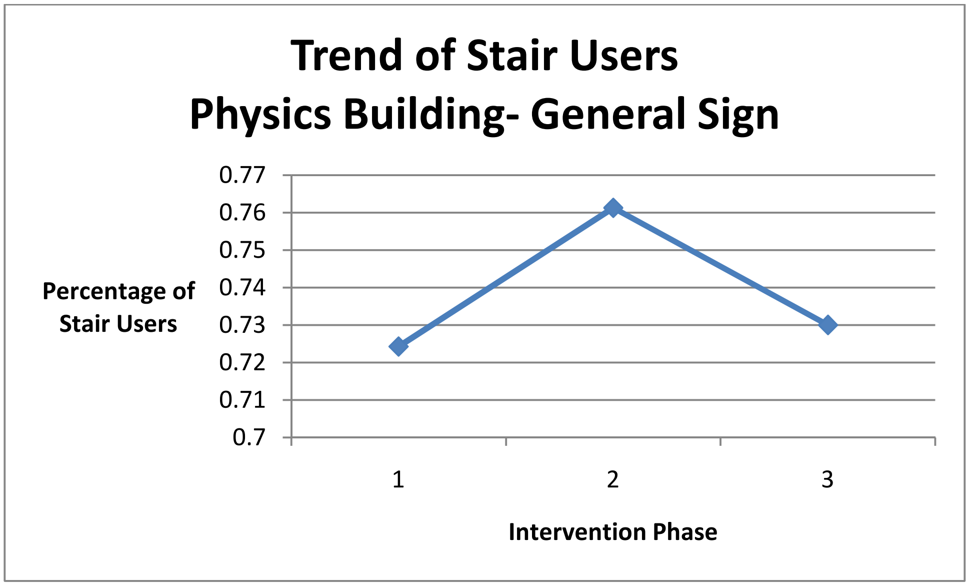

Figure 2

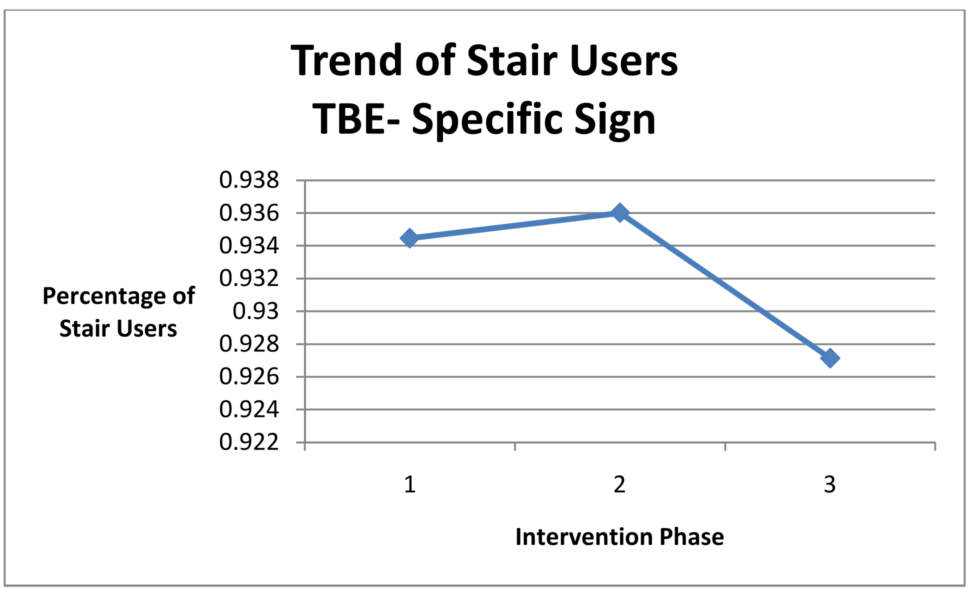

Table 4 was also used to determine the difference between buildings across a particular time period using a Chi Square distribution. Building 1, 2, and 3 were compared over the pre-intervention, intervention, and post-intervention phases. During the pre-intervention phase significance was indicated (x^2= 72.84, $p<0.0001$). The control (Geoscience) compared to the generic sign (Physics) showed significance ($p<0.01$), as did the specific sign (TBE) compared to the generic sign (Physics) ($p<0.01$) in the pre-intervention phase. There were significantly more stair users in the control and the specific sign buildings during the pre-intervention phase. When comparing the buildings during the intervention phase, significance was also found (x^2= 79.68, $p<0.0001$). The control building (Geoscience) and the specific sign building (TBE) were both significant compared to the generic sign (Physics) ($p<0.01$for both variables). Again, there were significantly more stair users in the control and specific sign buildings than the building with a generic sign during the intervention phase. Significance was shown for the building comparisons during the post-intervention phase (x^2= 62.24, $p<0.0001$). The control building (Geoscience) had significantly more stair users than the specific sign ($p<0.05$) and the generic sign ($p<0.01$) post-intervention, as did the specific sign compared to the generic sign ($p<0.01$).

CHAPTER 5

DISCUSSION

Main Findings

It was surprising to note the introduction of the signs in their respective buildings made no significant impact on stair usage. Previous literature (Bungum, Truax, & Meacham, 2008; Ford & Torok, 2008; Webb & Eves, 2007) has indicated that environmental prompts will positively influence stair usages rates. Yet, this study's findings were not consistent with previously published literature. There are two major plausible explanations for this inconsistency: a ceiling effect and the influence of the building environment.

The stair usage rates across all buildings and intervention phases indicate drastically higher stair usage rates than the other literature. It's highly possible that a ceiling rate exists. There were already high rates of stair usage during pre-intervention observation suggesting the rates of stair users could hardly increase any more. Compared to other research, our stair use rates are quite high. For example, Webb and Eves (2007) had baseline stair usage rates at 7% and intervention stair usage rates at 14.2%. Kerr, Eves, & Carroll (2001c) had baseline rates at 8.1% and improved these to 18.4%. Andersen, Franckowiak, Snyder, Bartlett and Fontaine (1998) observed 4.8% of their population taking the stairs at baseline and saw this improve to 7.2%. Russell and Hutchison (2000) began with a baseline stair usage rate of 8.22% and improved this to 14.98% and 14.40% based on the intervention their participants received. As seen in Table 4, the stair usage rates were much higher in this study than in comparative research. Because these rates were already quite high, it is difficult to show much change.

Major research has been conducted on the built environment and its influence toward encouraging or discouraging physical activity. The built environment can possibly trump other efforts, such as this one, made to increase physical activity among building users (Sallis, Bauman & Pratt, 1998). The lack of significant change within this study could be attributed to the built environment, including the location of the elevators and the staircase width. Nicoll (2007) described spatial measures including stair width and type as one of the largest predictors of stair usage. Nicoll (2007) explained a large stair width appeals to those travelling in groups because they can continue group conversation. For example, the staircase in the TBE building, which received the specific sign, is extremely wide and accommodating to people traveling in groups. Also, considering the proximity of the elevator to the stairs, it is neither more or less convenient to use the elevator than the stairs. One may even argue in a two-story building that using the elevator over the stairs when they are in such close proximity is less convenient. This may explain the high stair usage rates in the TBE building. The Geoscience building has an even stronger argument for the influence of the built environment. Its elevator is located outside the main building as a separate attachment. It appears as if it was an addition to the building later in order to accommodate updated building code requirements. Hardly any people used the elevator in this building because of its inconvenience in relation to the rest of the building. On the other hand, the Physics building's environment may discourage physical activity. The east staircase is entirely unappealing with its dark and narrow staircase, and the north staircase has a narrow width as well. Although both staircases are located upon entrance into the building, the elevator is conveniently located central to all main activity within the building including major offices, classrooms, and labs. Though this study made multiple efforts to encourage stair usage, the built environment may have a stronger influence for physical activity than the environmental prompts placed within the various settings.

Other Findings

As shown in Figures 1 and 2, this study saw slight increases in stair usage with the introduction of the environmental prompts. These may not have shown significance because of the high stair usage rate previously discussed. It's possible if these signs were introduced at a location where stair usage was much lower, they could have shown significance.

Using the Loglinear Model, the specific sign showed significance over the generic sign, but it's likely this is attributed to the number of stair users in each building versus the actual effectiveness of the sign. Though the model suggests the specific sign was effective, after further analysis it appears this cannot be attributed to the introduction of the specific sign.

Previous research showed younger women were more likely to use the stairs, followed by younger men, then older women, and lastly older men (Russell & Hutchinson, 2000). This study found that males were more likely to use the stairs. A possible explanation for the difference between males and females are the types of footwear frequently worn by women that make it uncomfortable or challenging to use the stairs. Other interventions could focus on the importance of wearing proper footwear throughout the day to encourage physical activity. Also, men and women are potentially motivated by different messages, and future research should examine potential messages that are effective at specifically targeting men or women.

Age was also a predictor of stair usage. Younger and middle aged populations were more likely to take the stairs as compared to older populations. This finding is consistent with previously published literature.

As Bungum, Meacham, and Truax (2007) indicated, the number of floors in a building is a predictor of stair usage. As suggested in this study, it appears two-story buildings may not need the focus of stair usage interventions like other multiple story buildings. Therefore, it might be wise to direct research on interventions in buildings that are more than two stories, at least on a university campus.

Limitations

There were limitations to this study. These buildings are not exact replicas of one another.   Therefore, other factors may influence the use of stairs, such as the built environment and structural design of each building. Also, this was an observational study, making age challenging to operationalize. Therefore, there may be discrepancies within the true meaning of the age significance. The researcher also attempted to be inconspicuous during the observation. But throughout the course of the study it was apparent that some recognized a scientific study was being conducted and the Hawthorne effect may have threatened internal validity. These buildings were not pre-tested. Pre-testing may have indicated that the stair usage rates in these buildings were already high and another location would have benefitted from this intervention. Lastly, some seasonal effects may have existed. It's possible that users of the stairs or elevator were likely to do so because of the hot or cold weather present during these times.

Future Research

Because of the unique implications of the high stair usage rates, in order to understand the effectiveness of these two signs, other research would need to be conducted. Settings could include shopping malls, casinos, or worksite settings. More research should be conducted in the built environment to assess the impact a building's construction can have on the use of stairs. As indicated by the various buildings assessed in the duration of this study, the built environment can play a significant role in influencing people to be physically active. Research could also be conducted in the types of environmental prompts that encourage stair usage for specific genders and age groups. A qualitative study could investigate certain motives and habits individual stair users have.

APPENDIX A

GENERIC SIGN

APPENDIX B

SPECIFIC SIGN

APPENDIX C

IRB APPROVAL

UNLV
UNIVERSITY OF NEVADA LAS VEGAS

UNLV IRB Approved DEC 16 2009 Expires

Biomedical IRB – Exempt Review
Approved as Exempt

DATE: December 18, 2009

TO: **Dr. Tim Bungum,** Epidemiology and Biostatistics

FROM: Office for the Protection of Research Subjects

RE: Notification of IRB Action by Dr. John Mercer, Chair JM/Lt
Protocol Title: **The Effects of Environmental Prompts on Stair Usage**
OPRS# 0912-3311

This memorandum is notification that the project referenced above has been reviewed by the UNLV Biomedical Institutional Review Board (IRB) as indicated in Federal regulatory statutes 45CFR46.

The protocol has been reviewed and deemed exempt from IRB review. It is not in need of further review or approval by the IRB.

Any changes to the exempt protocol may cause this project to require a different level of IRB review. Should any changes need to be made, please submit a **Modification Form**.

If you have questions or require any assistance, please contact the Office for the Protection of Research Subjects at OPRSHumanSubjects@unlv.edu or call 895-2794.

Office for the Protection of Research Subjects
4505 Maryland Parkway • Box 451047 • Las Vegas, Nevada 89154-1047

APPENDIX D

DATA COLLECTION INSTRUMENT

The Effects of Environmental Prompts on Stair Usage

Building: ___________________________________ Date: ________

Day of Week: ________ Time: ___:_____ am/pm-___:_____ am/pm

Observation: Baseline During Intervention After Intervention

Stairs	**Elevator**	**Gender**	**Age**	**Bags/ Backpack**
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N

↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N
↑ ↓	↑ ↓	M F	Y M O	Y N

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