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Fostering Sustainable Behavior Through Design: A Study of the Social, Psychological, and Physical Influences of the Built Environment

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**FOSTERING SUSTAINABLE BEHAVIOR THROUGH DESIGN: A STUDY OF
THE SOCIAL, PSYCHOLOGICAL, AND PHYSICAL INFLUENCES OF THE
BUILT ENVIRONMENT**

A Thesis Presented

by

NEIL G. CUMMINGS

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

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Department of Art, Architecture & Art History

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DEDICATION

I would like to dedicate this paper to my family, who has always been there to support me in all of my endeavors. I owe you everything.

ACKNOWLEDGMENTS

There are many people that I would like to acknowledge that have contributed to the success of this paper. First, I would like to thank all of the members of the Art, Architecture, and Art History department at the University of Massachusetts at Amherst for their continued support in the pursuit of knowledge on this topic. Second, I would like to thank the municipal governments of Washington D.C. and New York City for extensive help in obtaining statistical information regarding behavior patterns. My final thanks go to my family, who's continued love and support made possible the completion of my Master's degree and this research paper.

ABSTRACT

FOSTERING SUSTAINABLE BEHAVIOR THROUGH DESIGN: A STUDY OF THE SOCIAL, PSYCHOLOGICAL, AND PHYSICAL INFLUENCES OF THE BUILT ENVIRONMENT

MAY 2012

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The ultimate goal of this research paper was to gain a more acute perspective into the relationship between the physical environment and human behavior, so that architectural design may begin to promote and affect environmentally friendly behavior in its users. The three main fields of psychology that were the focus of this paper were social psychology, environmental psychology, and cognitive psychology, all of which were essential to understanding the unique relationship one has with their built environment.

The definitive goal of the sustainability movement, or what I at least think it should be, is the creation of an environmentally friendly society. The widespread use of sustainable architectural design practices has been a great step forward, but if this movement is to be successful, I feel we must focus equally on the relationship between people and their physical environments. Ultimately, the sustainability movement depends less on the architectural environments that we create, and more on the cooperation of the people who occupy those environments.

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CHAPTER 1

INTRODUCTION

“Belief in the significance of architecture is premised on the notion that we are, for better or for worse, different people in different places – and on the conviction that it is architecture’s task to render vivid to us who we might ideally be.”¹

For better or worse, human beings are products of their environment. This generally accepted characteristic of human behavior has been exploited in the past with both positive and negative intentions. For example, architectural design has been employed for thousands of years to affect targeted behavioral characteristics in its occupants. Religious organizations have seemingly used architecture for thousands of years as a means of inspiring respect, and even fear in order to affect subordinate behavior in its members. Psychiatric hospitals, more specifically those based on the system of design promoted by Thomas Kirkbride, were intent on promoting both mental and physical health in its patients.² The widely reproduced panoptic prison design, which allowed one guard to monitor the entire prison population without them being aware of whether or not they were being observed, was meant to create a sense of control over those incarcerated through the designed illusion that they were constantly being

¹De, Botton A., The Architecture of Happiness (New York: *Pantheon Books*, 2006) 13.

²Yanni, Carla, The Architecture of Madness: Insane Asylums in the United States (Minneapolis: *University of Minnesota Press*, 2007) 55-59.

watched.³ In the early years of the American government, the founding generation chose to base the federal style of architecture on the classical styles of Greece and Rome, in order for the young government to associate itself with and inspire within its population the values of those ancient cultures.⁴

“Yet the relatively low amount of green building taking place, the expanding amount of sprawl, and the increasing size of homes all point to a consuming public that is actually moving in the opposite direction of environmental sustainability.”⁵

Recently, with the effects of society’s activities on the ecological environment becoming increasingly more visible, there has been a surge of social concern regarding the well being of the natural environment, and with these concerns came technological and informational advancements intended to alleviate the impact on our ecosystem. Technological advancements in the design fields have allowed us to reduce, or even eliminate the ecological impact of a built environment, and in some cases may even rehabilitate the ecosystem. Advancements in the wealth of information regarding the measured effects of our population’s impact on the natural environment have provided us with significant amounts of evidence that our activity and behavior patterns are harming our ecosystem. Therefore, due to these advancements, it would seem that society as a

³ Bentham, Jeremy, and Miran Bozovic, The Panopticon Writings (London: Verso, 1995) 29-95.

⁴ Craig, Lois A, The Federal Presence: Architecture, Politics, and National Design (Cambridge, MA: MIT Press, 1984) 1-580.

⁵ Hoffman, Andrew, and Rebecca Henn, Overcoming the Social and Psychological Barriers to Green Building (*Organization & Environment*, 21.4, 2008) 397.

whole was progressing toward a model of environmental responsibility. For the most part, however, these advancements seem to have had little effect at influencing human behavior to reflect this knowledge.

“Human behavior and habits can enhance or frustrate environmental sustainability efforts in the reduction of carbon footprint, indoor air quality, emissions, and impact to the natural environment.”⁶

The affective distribution of the knowledge mentioned before seems to have been fairly limited, and the majority of the general population continues to act and behave in manners that are detrimental to the natural environment. In order to design a truly sustainable environment, one must consider not only the ecological impact of the structure itself, but also how it will affect the behavior of the people in and around this built environment. The reason that I stress this is that ultimately, human beings and their patterns of activity are the most significant contributor to environmental degradation. One environmentally sustainable building will have little impact if it's several hundred employees continue to act and behave in manners that are detrimental to the natural environment. Therefore, in an attempt to create a truly sustainable environment, the most significant factor to consider should be the activities and behaviors of its occupants.

⁶ Bay, J.H., Towards a Fourth Ecology: Social and Environmental Sustainability with Architecture and Urban Design (*Journal of Green Building*, 5.4, 2010) 190.

“The interplay between human behavior and the physical environment engages a complex and little understood network of personal, societal, and physical variables.”⁷

Although buildings and their operation are responsible for a significant percentage of total greenhouse gas emissions, ultimately, they are inhabited and operated by human beings, so merely creating an architectural environment conducive to sustainable behavior is not sufficient. In order to create a truly sustainable environment, a design must be able to inspire and affect environmentally friendly activity in those that are directly involved in its use, and if possible, those who experience it as a passer-by. By understanding the social, psychological and physical influences that an individual experiences when interacting with their artificial environment, one may more successfully design an environment that encourages and affects ecologically friendly behavior.

There has been little research completed on the measured effects of sustainable design on human behavior either in or around a specific built environment. Additionally, the research that has been completed has been motivated primarily by the possibility of financial gain. Increased daylighting, which is a core component of sustainable architectural design, has been found to increase the levels of sales in retail environments.

^{8 9} An increased visual connection to the outdoors, a more comfortable indoor

⁷ Craik, Kenneth H., The Environmental Dispositions of Environmental Decision-Makers (*The Annals of the American Academy of Political and Social Science*, 389, 1970) 89.

⁸ Heschong, Lisa, Daylight and Retail Sales: Technical Report (Sacramento, CA: *California Energy Commission*, 2003) 49.

environment, in addition to increased daylighting, has been found to improve employee performance and well being in office environments.^{10 11 12 13 14 15} Many of these same components of architectural design have also been found to have similar impacts in a classroom environment.^{16 17 18 19 20 21} Despite being interesting and compelling, not one

⁹ Heschong, Lisa, Skylighting and Retail Sales: An Investigation into the Relationship between Daylighting and Human Performance (San Francisco, CA: *Pacific Gas and Electric Co.*, 1999) 12-13.

¹⁰ Heschong, Lisa, Windows and Offices: a Study of Office Worker Performance and the Indoor Environment: Technical Report (Sacramento, CA: *California Energy Commission*, 2003) 137-41.

¹¹ Abbaszadeh, S., Zagreus, Leah, Lehrer, D., & Huizenga, C, Occupant Satisfaction with Indoor Environmental Quality in Green Buildings (eScholarship, *University of California*, 2006) 6.

¹² Lei, Q.H, William J. Fisk, and Olli Seppanen. Effect of Temperature on Task Performance in Office Environment (Washington, D.C: United States. *Department of Energy*, 2006. 2-8.

¹³ Liu, Gang, William J. Fisk, Dennis Dibartolomeo, Phillip Price, David Faulkner, Douglas Sullivan, Cliff Federspiel, and Maureen Lahiff. Worker Productivity and Ventilation Rate in a Call Center: Analyses of Time-Series Data for a Group of Workers (Berkeley, CA: *Lawrence Berkeley National Laboratory*, 2002) 1-6.

¹⁴ Heerwagen, Judith, Green Buildings, Organizational Success and Occupant Productivity (*Building Research and Information*. 28.5 (2000): 353-367.

¹⁵ Heerwagen, J. and Zagreus, Leah, The Human Factors of Sustainable Building Design: Post Occupancy Evaluation of the Philip Merrill Environmental Center (eScholarship, *University of California*, 2005.) 1-28.

¹⁶ Heschong, Lisa, Windows and Classrooms: a Study of Student Performance and Indoor Environment: Technical Report (Sacramento, CA: *California Energy Commission*, 2003) 109.

¹⁷ Heschong, Lisa. Daylighting in Schools: An Investigation into Relationship between Daylighting and Human Performance; Detailed Report (Fair Oaks, CA: *Pacific Gas and Electric Company*, 1999) 24.

¹⁸ Hathaway, Warren E., A Study into the Effects of Light on Children of Elementary School Age: A Case of Daylight Robbery (Edmonton: Policy and Planning Branch, *Alberta Education*, 1992) 1-68.

¹⁹ Green Schools: Attributes for Health and Learning (Washington, DC: *National Academies Press*, 2007) 1-193.

²⁰ Kuller, R, and C Lindsten, Health and Behavior of Children in Classrooms with and Without Windows (*Journal of Environmental Psychology*. 12.4 (1992): 305-317.

of these studies address the current social issue of environmental responsibility, and in my research I have found no such study. Sustainable architectural design must not only concern itself with the productivity or well being of its occupants, but also the behavior of those people in and around the structure, for if there is to truly be a movement toward sustainability, people's behaviors and activities must change, and not merely their built surroundings.

Clifford Drew writes, "There has been a long-standing awareness that the physical environment could be manipulated to achieve obvious physical or behavioral results... Conceptualization of these effects requires considerable abstractness and is substantially more complex and less visible, and implementation often presents difficulty. These difficulties are readily evidenced by man's early attempts to deal with mental health."²²

The effects of the built environment on individual activity and behavior is commonly underestimated, and in order to successfully foster sustainable development through a work of design, it is extremely important that the designer understand the psychological, social, and physical influences regarding the interaction between the individual and the built environment. Sustainable development, as defined by the World Commission of Environment and Development, is a process that satisfies the needs of current generations, while at the same time ensuring that the needs of future generations

²¹ Nicklas, M, and G Bailey, Student Performance in Daylit Schools: Analysis of the Performance of Students in Daylit Schools (*Proceedings of the National Passive Solar Conference*, 21 (1996): 132-137.

²² Drew, Clifford J, Research on the Psychological-Behavioral Effects of the Physical Environment (*Review of Educational Research*, 41.5, 1971) 447.

can be met.²³ If this is to be accomplished, then current behavior patterns, especially those at the level of the individual, need to be drastically changed. The built environment plays a large role in determining the nature of behavioral patterns, and therefore if we are to meet the goals defined by the practice of sustainable development, then those in the design professions must begin to acknowledge the social, psychological, and physical influences of the artificial environment that determine environmentally friendly behavior.

²³ Brundtland, Gro H., Report of the World Commission on Environment and Development: "our Common Future (New York: *United Nations*, 1987) 1-374.

CHAPTER 2

SOCIAL INFLUENCES OF THE BUILT ENVIRONMENT

2.1 Introduction

Research in the field of social psychology play an important role when attempting to affect environmentally friendly behavior in a building's users. Much of this research focuses on different factors particular to the individual, which are able to help predict certain behavioral patterns regarding sustainable behavior. For instance, research performed by Eero Olli found that there is a positive correlation between the age of the individual and their tendencies to behave in an environmentally friendly manner. The study found that the higher the age of the individual, the higher the likelihood that they will participate in environmentally friendly activities. The results from this research also suggested that women had a higher tendency than men to perform activities considered to be environmentally friendly.²⁴ Although this research is very interesting, there seems to be no valid method of applying it to a building design in order to affect environmentally friendly behavior in its users. This research focused mainly on characteristics of the individual that were helpful in determining patterns of behavior. The studies I will discuss next focus more on the social context of the environment, which I hope will be more helpful and more applicable to the design of a building, and which will help shape patterns of behavior in and around that building.

²⁴ Olli, Eero, Gunnar Grendstad, and Dag Wollebaek, Correlates of Environmental Behaviors: Bringing Back Social Context (*Environment and Behavior*, 33.2, 2001) 200.

2.2 Analysis of Social Psychology as Related to Sustainable Design

“As with other problems, environmental problems are neither caused nor solved by single individuals. People depend on the cooperation of others. The extent to which people believe that others are willing to help solve environmental problems is an important influence on their own willingness to change.”²⁵

There has been a long-standing general assumption that the activities and behaviors of others have a strong influence on our own activities and behaviors, which had been studied by countless research bodies. Although one’s egocentric view of the self may attempt to deny this, the extensive research on the subject has found strong evidence to support this hypothesis. Studies conducted have found that the social context plays an extremely important role in determining the behavior of the individual while in that social setting. Therefore, it seems logical to think that social influences are also a significant factor when attempting to decipher the causes and nature of environmentally friendly behavior.

“Thus, the search for social support for one’s own environmental behavior may be an important determinant of that behavior.”²⁶

This information may prove to be very useful in the design of an artificial environment that affects environmentally friendly behavior. The research discussed

²⁵ Uzzell, David, Eric Pol, and David Badenas, Place Identification, Social Cohesion, and Environmental Sustainability (*Environment and Behavior*, 34.1, 2002) 49.

²⁶ Bratt, Christopher, The Impact of Norms and Assumed Consequences on Recycling Behavior (*Environment and Behavior*, 31.5, 1999) 632.

previously, which found that there were positive correlations between the age and sex of the individual and environmentally friendly behavior, is essentially useless in the context of an affective building design. It is not possible for an architectural design to cater only to women and people of higher age, and claim that it has successfully created a built environment that affects environmentally friendly behavior. However, the idea that the actions of others affect our own behavior may very well be applicable in architectural design.

“Furthermore, it is presumed that the presence of strong social cohesion and consequently a strong sense of identity will lead to environmentally altruistic behavior. Therefore, the route to sustainability is one of social cohesion leading to place-related social identity, which in turn leads to pro-environmental behavior.”²⁷

Therefore, if we accept that these statements are valid, then an architectural design can encourage environmentally friendly behavior if it first establishes a model of social cohesion. Though, how does an inanimate object become an objectification of social processes? To think that an artificial creation can be a determining factor in affecting such natural occurrences may seem like a great deal of a stretch to many, if not most. However, with recent advances in building and operational systems technologies, I feel that the artificial, or built environment is entirely capable of playing such a role in social contexts.

²⁷ Uzzell, David, Enric Pol, and David Badenas, Place Identification, Social Cohesion, and Environmental Sustainability 30.

Models of social identity, it seems, take a relatively significant amount of time to establish in individuals. There is a kind of lag between the individual's initial exposure to the environment and the establishment of a corresponding social identity. If, for instance, we consider an office environment, which happens to be highly dedicated to environmentally friendly behavior, then I believe an example of this lag time becomes clearly visible. When a recently hired employee arrives at this new environment, they will likely not be entirely aware of the importance of which sustainable behavior is held. Although they may observe the generous availability of recycling containers, if I may use the abundance of recycling containers as a gauge of environmental responsibility, it does not guarantee that they themselves will engage in their use. As discussed earlier, simply the creation of an environment that is conducive to environmental responsibility does not guarantee its effectiveness. Only upon the continued observance of fellow employees using the recycling containers, will the recently hired employee begin to adopt his or her own social identity to correspond with those of their colleagues. Therefore, in this instance, there is indeed a lag time between the initial exposure of an environment and the establishment of a strong social identity.

Within the recent development of information-based building systems monitoring, I feel there is an opportunity to reduce, or even eliminate this delay in the creation of a strong social identity. Generally speaking, these new kinds of technology allow for a building's performance, mainly in terms of energy use, to be viewed by the building's users via display monitors. This unique experience in an architectural environment creates an interactive dialogue between the occupant and the building, providing the user with the opportunity to gauge their own behavior, and to think how they might have contributed to

the information that is being displayed to them. Additionally, thinking again of the context of a new employee in an office environment, the provision of this information establishes a social norm for that environment. In the displaying of information regarding a particular environment's energy efficiency, it suggests to the new occupant that there are already practices of environmental responsibility firmly rooted in the behaviors of his or her colleagues. These building systems performance information displays make the lengthy, continued observance in the hypothetical situation discussed in the previous paragraph occur almost immediately. They digitally establish a social norm even before the individual has the opportunity to observe them first hand, reducing, and possibly even eliminating that lag time observed in the previous situation.

CHAPTER 3

PSYCHOLOGICAL INFLUENCES OF THE BUILT ENVIRONMENT

3.1 Introduction

The psychological processes that an individual undergoes when set in an artificial environment may also offer some suggestions when trying to overcome the problem of affecting sustainable behavior in building occupants. The built environment plays an extremely important role in the cognitive reactions of an individual, and an understanding about this relationship can help to determine and predict the activity and behavior of a building's occupant. The development of environmentally friendly behavior in building users is an extremely complicated task, and one that cannot be accomplished easily or simply. There are countless factors to consider when attempting to influence user behavior, and even when many or all of these factors are considered, the desired behavior is not always achieved. Individual attitude and intention differ greatly, and therefore there cannot be one overarching answer of how to affect environmentally friendly behavior in a building's occupants.

3.2 Analysis of Cognitive Psychology as Related to Sustainable Design

In order to change one's attitude, and potentially their behavioral patterns, Katherine Arbuthnott writes, "Thus, scientific knowledge of the consequences of environmental degradation, and public information campaigns that educate citizens about

the benefit of individual action, can potentially influence behavior.”²⁸ I feel that this information potentially reveals methods that may be employed in the design professions in order to affect certain kinds of behavior, specifically those that are environmentally conscious. Knowledge about a certain social issue will likely influence an individual to act, although this action may be either a positive or negative reaction to the knowledge presented. However, I feel that by disseminating information about the current environmental crisis we are, or will soon be facing, there will be an opportunity to address the morals and values of those in and around a building.

There are many ways in which this information might be used to promote certain kinds of activities and behaviors within a given built environment. Most simply, signs that display such scientific knowledge within a building or aim to educate the building’s users on the impact of their behaviors on the natural environment have great potential to change the user’s behavior to reflect environmentally responsible values. The recent development of information-based building performance monitoring systems also offer an opportunity to distribute knowledge to the individual about their potential impact on the built environment. The receiving and interpretation of the information regarding the current state of the environment will address an individual’s morals and values. Once the individual receives and interprets this information, they will be forced to recognize what their position is on the issue, which in turn will likely lead to a change in behavior.

Intention is an extremely important factor to consider when trying to predict and influence building user behavior. However, a change in intention or attitude does not

²⁸ Arbuthnott, Katherine D, Education for Sustainable Development Beyond Attitude Change (International Journal of Sustainability in Higher Education, 10.2, 2009) 153.

always result in a change in behavior. Arbuthnott continues, "...Although behavior change was associated with intention change, behavior did not change in response to intervention as much as expressed intentions did. In other words, we do not always do what we wish or say we do."²⁹ Just because a building is able to promote environmentally friendly attitudes and intentions, it does not mean that the user's behavior will reflect those intentions and attitudes regarding environmental responsibility. In order to effectively affect environmentally responsible behavior in a given built environment, the designer must consider this information, and adapt the design to more effectively promote such kinds of behavior.

As discussed earlier, individual attitudes and intentions are an important determinant when trying to predict behavior. In order to better understand the behavior of the individual in a specific built environment, one must take these lessons into account. Arbuthnott writes, "The more personal and specific our intentions are, the more likely they are able to influence our behavior. For instance, we are more likely to act consistently with attitudes about our own needs than attitudes about the needs of others or the generic environment."³⁰ This statement suggests that the individual is more or less concerned primarily with the satisfaction of their own needs, rather than the needs of the collective. In order to alleviate this situation and lead the individual to become concerned with the needs of the collective, or in this case, the needs of the natural environment, the artificial environment must make an attempt at personalizing the concern for

²⁹ Arbuthnott, Katherine D, Education for Sustainable Development Beyond Attitude Change 154.

³⁰ Arbuthnott, Katherine D, Education for Sustainable Development Beyond Attitude Change 154.

environmentally friendly behavior. Concern for the wellness of the environment, largely considered a collective issue, must be brought down to the level of the individual. There is no concrete answer for how a built environment may accomplish this, and I may offer only suggestions. As discussed earlier, the employment of signage or building systems displays within a built environment that highlights the impact of the individual's behavior and activities on the condition of the natural environment will, theoretically, influence the attitudes of those individuals concerning environmentally friendly behavior. By addressing the actions and behaviors of the individual, we will be able to force the individual to recognize what their moral position is on the subject, hopefully resulting in a change in behavior.

Arbuthnott also writes, "...we are less likely to make behavior changes when we believe that our efforts will not make a difference, especially when the behavior in question is effortful, costly, or inconvenient."³¹ From this statement, we gather that unless the individual can observe the benefits resulting from his or her activities, affecting behavior that is desired by the designer will not be possible. Therefore, unless a building's user can directly observe the impact that their environmentally friendly behavior is making, they will not act accordingly. Once again, a built environment's use of signage and building systems displays seem to have a strong relationship when confronting this issue. The presence of these, especially of the building systems displays, will allow the individual to see first-hand what kind of impact their behaviors are having on the natural environment, leading them to behave in an environmentally friendly manner. Additionally, the more individual-specific these display systems are made, the

³¹ Arbuthnott, Katherine D, Education for Sustainable Development Beyond Attitude Change 155.

more likely they are to influence behavior. For example, an energy-use monitoring system that displays information for the individual's office, theoretically, will be more effective than a similar system that displays information for the entire building. As stated earlier, directly engaging the individual and presenting them with information regarding their own behavior will be able to tap into their moral standards and ideals, forcing them to recognize what their position on the issue is, and likely resulting in a corresponding behavioral change.

Yet another study looked into the effects of an individual's emotional sympathy toward nature as a way of gauging to what extent the individual will act to protect the natural environment. What was found in these studies may have strong implications for the design fields, especially if it is the goal of the designer to affect environmentally responsible activities and behaviors in a design's users. Elisabeth Kals writes, "Emotional affinity toward nature proved to be as important for the prediction of nature-predictive willingness and behavioral decisions as interest in nature and indignation about insufficient nature protection."³² This statement also begins to address the role of psychological processes of an individual in determining the activities and behaviors of that individual in a given environment.

Applying this research to the field of architecture may not be as simple as it seems, since the word "affinity" implies an emotion that is inherent, and therefore it is not guaranteed that all individuals will be affected the same way. However, if there is even a slight chance that behavior patterns will shift to reflect more environmentally

³² Kals, Elisabeth, Daniel Schumaker, and Leo Montada, Emotional Affinity Toward Nature As a Motivational Basis to Protect Nature (*Environment and Behavior*, 31.2, 1999) 194.

friendly attitudes, even if in a relatively small portion of the population, then I feel that it should be given merit. In an attempt to inspire this sort of emotional connection between an individual and the natural environment, those in the design professions may create a built environment that, to the best of the designer's ability, emulates the qualities of nature. In attempting to foster an emotional affinity toward nature, it seems possible that a built environment that embodies elements of the natural environment will be able to affect sustainable behavior, even in those that initially lack any basis of an emotional connection toward nature. If an emotional connection between an individual and the natural environment is indeed created, it is likely that the individual will change his or her behavior to protect that environment.

Similar to the ideas about emotional connection and the influence they have on behavior described above, research has found that an individual's sense of place greatly influences behavioral patterns. To provide a working definition of this concept of the individual's environment, Richard Stedman writes, "Sense of place can be conceived as a collection of symbolic meanings, attachment, and satisfaction with a spatial setting held by an individual or group."³³ What I am concerned with most here is the concept of place attachment, which I feel would play a significant role when trying to predict levels of environmentally friendly behavior. It would seem logical to conceive that if an individual felt a great sense of attachment to a particular place, then they would be more likely to act to protect the qualities of that place. Continuing on this idea, Enric Pol and Angela Castrechini write, "...People with a higher sense of attachment showed a higher

³³ Stedman, Richard C, Toward a Social Psychology of Place: Predicting Behavior from Place-Based Cognitions, Attitude, and Identity (*Environment and Behavior*, 34.5, 2002) 563.

propensity to sustainable behaviors.”³⁴ As far as the architectural implications of this research goes, it would seem to be unrelated and insignificant, for how can an architectural design foster a greater sense of attachment between itself and its occupant? However, I would beg to differ, for, as will be discussed in more detail later in this paper, there are those that claim every human being inherently and genetically contains a kind of an emotional connection to the natural world.³⁵ Therefore, it would seem plausible to think, stemming from this statement, that by creating an artificial environment containing elements of nature, one would theoretically be able to foster a greater sense of attachment between the place and the occupant. An increased sense of attachment to a particular place will, according to the research discussed previously, likely increase the tendency of environmentally friendly behaviors and activities.

The psychological processes of the mind of the individual embody an important aspect of the relationship between the individual and their built environment when trying to affect environmentally friendly behavior through an architectural design. Each individual is unique, and therefore it would seem invalid to present a single answer to address this problem. However, the psychological processes we each undergo are fairly similar, and by addressing these, the designer may become more adept at predicting and influencing ecologically sustainable behavior in the occupants of a given artificial environment.

³⁴ Pol, Enric, and Angela Castrechini, City-identity-sustainability Research Network: Final Words (Environment and Behavior, 34.1, 2002) 155.

³⁵ Joye, Y., Architectural Lessons from Environmental Psychology: the Case of Biophilic Architecture (Review of General Psychology: Journal of Division 1, of the American Psychological Association, 11.4, 2007) 323.

CHAPTER 4

PHYSICAL INFLUENCES OF THE BUILT ENVIRONMENT

4.1 Introduction

“The city as a physical structure serves to condition social interactions by either facilitating or impeding them. The physical shape of the city also molds attitudes toward the environment.”³⁶

Not only does the physical environment play a strong role in determining social interaction, but it also plays an equally significant role in determining activity and behavior. The physical environment is a significant determinant when trying to predict specific kinds of behaviors and activities, and to disregard it as unimportant in influencing behavior would be imprudent. In terms of a work of design, the built environment can play an either conducive or restrictive role in fostering sustainable development in both its users and visitors. Obviously, an environment that does not encourage sustainable behavior will not be able to inspire individuals to act as so. Therefore, in the most basic sense, in order for a building to foster environmentally friendly behavior in those in and around the building, one must first create and environment that makes those kinds of activities both convenient and socially acceptable.

³⁶ Pol, Enric, The Theoretical Background of the City-Identity-Sustainability (CIS) Network (*Environment and Behavior*, 34.1, 2002) 14.

4.2 Analysis of Environmental Psychology as Related to Sustainable Design

A major factor to consider when trying to affect environmentally friendly behavior is the convenience of such activities. Arbuthnott writes, “When there are barriers to an intended behavior, such as an inconvenience or cost, behavior change is less likely regardless of intention.”³⁷ She adds, “In the current social environment, acting in environmentally-responsible ways is often difficult, either physically (e.g. inconvenient recycling programs and public transportation) or socially (e.g. vehicles as symbols of social status).”³⁸ In order for a built environment to effectively promote environmentally friendly behavior, it must make the achievement of those activities as convenient as possible. For example, if a work of architectural design was trying to encourage more people to use alternative transportation, such as biking, bicycle racks must be conveniently located. Additionally, easily locatable shower and locker rooms will make the pursuit of this activity much more convenient and available to the individual.

While convenience may be an important determinant in predicting environmentally friendly behavior, simply making an activity convenient does not guarantee that the desired activity or behavior will occur. Arbuthnott continues, “Delaying gratification necessarily requires self-control, so even in a culture that has made environmentally-sustainable behaviors more convenient and normative, there will

³⁷ Arbuthnott, Katherine D, Education for Sustainable Development Beyond Attitude Change 156.

³⁸ Arbuthnott, Katherine D, Education for Sustainable Development Beyond Attitude Change 158.

always be some individual effort involved.”³⁹ Once again, to better motivate the individual, an architectural design may include the use of energy-monitoring displays, which would allow the building user to directly observe what kind of impact their behaviors or activities are having on the natural environment.

There are some, contrary to the suggestions made in the previous paragraph, who suggest that all human beings have an inherent emotional affinity toward nature, at least at some level. Yannick Joye, in his discussion of biophilic architecture writes, “...humans are affectively related to specific natural elements and settings, being the result of human evolution in a natural environment.”⁴⁰ This statement suggests that all human beings, even those who don’t consider themselves environmentally conscious, contain a genetically engrained emotional connection to the natural world. If this is true, then, if continuing on the idea that an emotional affinity toward nature is directly associated with environmentally friendly behavior, then it is not necessary to first establish an emotional connection, since all human beings already contain such a connection. Rather, for those with more subdued emotional connections toward the natural environment, if the goal of a work of design is to foster sustainable behavior in its users, then it is only necessary to enhance this previously existing condition.

³⁹ Arbuthnott, Katherine D, Education for Sustainable Development Beyond Attitude Change 161.

⁴⁰ Joye, Y., Architectural Lessons from Environmental Psychology: the Case of Biophilic Architecture 323.

“...By including elements of ancestral habitats in the built environment, one can counter potential deleterious effects, which stem from this dominance, resulting in more positive affects and more relaxed physiological and psychological states.”⁴¹

Although here, Joye states that a built environment that emulates elements of the natural world will improve the physical and psychological conditions of the individual, he also suggests that by including these natural elements, one can improve the condition of the built environment itself. Inclusion of natural elements in the built environment will likely cause an increase in emotional affinity toward the natural environment, which, as mentioned earlier, is linked to ecologically friendly human behavior. Joye suggests that, in its most basic form, this model of architectural design would likely include the thorough use of vegetation and water features.⁴² The employment of these natural elements in a built environment would, theoretically, lead to an increased emotional connection to nature, and therefore would increase the possibility of a design successfully affecting environmentally friendly behavior.

Additionally, Joye suggests both the literal and schematic use of natural elements in an architectural design, which might also be able to reveal an individual’s inherent emotional connection to the natural environment, thus leading to increased levels of environmentally friendly behavior.⁴³ Here, Joye suggests that by imitating natural forms

⁴¹ Joye, Y., Architectural Lessons from Environmental Psychology: the Case of Biophilic Architecture 311.

⁴² Joye, Y., Architectural Lessons from Environmental Psychology: the Case of Biophilic Architecture 308.

⁴³ Joye, Y., Architectural Lessons from Environmental Psychology: the Case of Biophilic Architecture 313.

or patterns in an architectural design, one can begin to establish an emotional connection between the occupant and their built environment.

There are some that consider general awareness of ecological issues as an important determinant of environmentally sustainable behavior. In his discussion on this topic Thomas Arcury writes, “The relatively strong positive correlation of education to both knowledge about the environment and attitude toward the environment does suggest that knowledge leads to attitude.”⁴⁴ In this sense, it seems possible that by providing information within a built environment about the benefits of environmentally responsible behavior, that building users will become more knowledgeable about these issues, and in turn will change their behavior to reflect this new knowledge. I acknowledge that is a very tentative issue because of its generalizations. Here, we are generalizing that all individuals think and behave similarly, when in fact the opposite is most likely to be true. Despite this, I feel that this information may provide designers with a method for positively influencing environmentally friendly behavior.

Continuing on the idea that knowledge about a particular environment will result in behavioral changes, Clifford Drew writes, “Despite the plausibility of environmental learning, it is reasonable to suspect that a person’s learning about his surroundings will produce a range of reactive tendencies from which prediction is possible.”⁴⁵ Generally speaking, an individual will inherently learn from his or her environment, which will then result in a change in behavioral patterns directly related to that knowledge. If applied to

⁴⁴ Arcury, Thomas A., Environmental Attitude and Environmental Knowledge (*Human Organization*, 49.4, 1990). 303.

⁴⁵ Drew, Clifford J, Research on the Psychological-Behavioral Effects of the Physical Environment 456.

the problem of fostering environmentally friendly behavior via a work of design, knowledge about this problematic ecological issue will theoretically result in a change in behavior regarding environmental sustainability. However, the statements made by Drew suggest that the resulting behavior changes could be due to either a positive or negative reaction to the information and knowledge presented. For example, an individual that learns from his or her surroundings about the benefits of recycling may adapt their behavior to either reject or accept this information. Once again, there is no guarantee that by making someone more knowledgeable on environmentally friendly activities and practices that they in turn will become more environmentally responsible. Drew suggests here rather, that the opposite is entirely possible. Unfortunately, one may be immersed in information detailing certain activities that can reduce one's ecological impact, and at the same time may actually increase their environmentally harmful behavior.

These studies previously discussed concerned themselves primarily with ideas about individual intentions and attitudes, which directly resulted in corresponding behavioral patterns. This next study focused on a more spiritual aspect of man's relationship with his physical environment. They write, "We hypothesize that, other things being equal, environmental concern and behavior are a function of a sense of connectivity with nature. People who sense a fundamental sameness between themselves and the natural world (as well as to other people) will feel more empathetic and compassionate toward nature."⁴⁶ They continue, "This connectivity is not only about seeing the environment as part of ourselves but also about seeing ourselves as part of the

⁴⁶ Dutcher, Daniel, James Finley, A.E Luloff, and Janet Johnson, Connectivity with Nature As a Measure of Environmental Values (*Environment and Behavior*, 39.4, 2007) 478.

environment. Connectivity with nature reflects a sense of empathy because of the unity/communion between self and nature that is inherent in the concept.” They concluded, “Our connectivity scale was significantly and positively associated with both environmental concern and environmental behavior...”⁴⁷ Taken in the simplest sense, this study suggests that a connection to the natural environment, whether it is physical, psychological, or spiritual, will theoretically result in environmentally friendly behavior. This research, though tentative, has far reaching implications for the field of architecture, as well as for the other design professions. If it were the intention of the designer to promote and affect environmentally friendly behavior and concern in its users, an effective method of accomplishing this goal would be to establish a level of connectivity between the building’s users and the natural environment. This is a very broad statement, which can seemingly be approached many ways. The first, and most obvious solution that comes to mind would be to create a physical connection between the user and the natural environment. This can be accomplished through the employment of vegetation in an architectural design (e.g. trees, shrubs, etc.). Loosely based on the research quoted previously, by providing physical representations of the natural environment in a work of design, the user may very well likely develop a sense of compassion, or empathy toward the environment, which in turn will result in a change in the user’s behavior. In the field of architecture, however, providing significant amounts of natural vegetation is not always a possibility. At some point in an architectural design, the user will migrate from the exterior to the interior of a building, where the possibilities to provide vegetation is

⁴⁷ Dutcher, Daniel, James Finley, A.E Luloff, and Janet Johnson, Connectivity with Nature As a Measure of Environmental Values (*Environment and Behavior*, 39.4, 2007) 489-90.

less of an option. In this case, the architect may resort to other methods that may effectively establish a level of connectivity between the building's user and the natural environment. The designer may employ naturally occurring materials in his or her work in order to develop a connection between the user and the natural environment, even on the interior of a building. For example, the extensive use of wood products within a built environment may, theoretically, effectively promote a level of connection between the user and the natural environment, which, according to the research discussed earlier, would result in a pattern of environmentally friendly behavior and concern.

CHAPTER 5

CASE STUDIES

5.1 Introduction

Near the beginning of my research, I felt compelled to study specific built projects in order to gain a better understanding of how they affected their respective immediate and surrounding populations. I chose these projects based on their purported environmentally sustainable qualities, and studied, to the best of my ability, the impact that they had on the local community. Although much of this research is tentative and I am by no means a statistical expert, I believe that the data that was gathered during these studies may offer insight into the effects of the built environment on human behavior. My goal throughout this period of research was to find a correlation between the completion of an environmentally sustainable building and a social movement toward environmentally responsible behavior. Again, I state that this research is quite tentative, because, as it has been exclaimed, correlation does not entirely guarantee causation. However, to the best of my ability, I have taken into account external factors that may have influenced this collected data so that it may become more relevant to the topic of this paper.

The two central built projects that were the focus of this research were the Sidwell Friends Middle School located in Washington, D.C., and the Queens Botanical Garden, located in Flushing, NY. As mentioned earlier, I chose each of these projects because of their purported environmental responsibility, as each project was awarded the LEED Platinum certification. Having received the highest level of certification regarding

environmental sustainability. I chose both projects in the hope that they would have had a significant impact on the behavior of their respective communities. One of the questions I have continually asked throughout the research process was, “Is simply a LEED seal of certification sufficient to promote and inspire environmentally sustainable behavior?” My guess was that it would not, since it seems that most people are not sufficiently educated in what LEED actually stands for and represents. Furthermore, even if one were aware of the actual meaning of the LEED rating, would they know what were the qualifications that determined the rating given? These were the questions that I posed when beginning my research, however by the end of all the data collection, these remained seemingly unanswered, and I was left with even more questions than when I had began.

5.2 Sidwell Friends Middle School

The Sidwell Friends Middle School, completed in September 2006, is a 72,500 square foot education facility designed by KieranTimberlake Associates.⁴⁸ The design included a 33,500 square foot renovation, as well as a 39,000 square foot addition, which was meant to house a total of 350 students. Wastewater from the kitchen and bathrooms is treated in the Middle School’s artificial wetland, which is meant to serve as a “living laboratory” for students. Students use stormwater captured on the green roofs of the complex to grow herbs and vegetables, while excess water is used in the School’s pond and rain garden. The facility provides bicycle storage, as well as belowground parking spaces, which each contribute to decreasing stormwater runoff. The building is oriented to take advantage of passive solar design, and includes the use of light shelves and

⁴⁸ United States Green Building Council, Project Profile: Sidwell Friends Middle School, Washington, DC (USGBC, 2007). 1-2. PDF file.

shading devices allow daylight to penetrate deep into the interior spaces, while at the same time reducing solar heat gain and glare. The Middle School’s design features extensive use of recycled and rapidly renewable materials, as well as finishes with low chemical emissions. Additionally, all teachers are able to access the building’s landscape and building systems, and are encouraged incorporate them into their lessons.



Figure 1: View of the Exterior Courtyard of Sidwell Friends Middle School; “Sidwell Friends Middle School”; Isiah King, 14 June 2009; flickr.com; 15 Nov. 2010.



Figure 2: View of the Exterior Façade of Sidwell Friends Middle School; “Sidwell Friends Middle School”; Isiah King, 14 June 2009; flickr.com; 15 Nov. 2010.



Figure 3: View of the Interior of Sidwell Friends Middle School; “Sidwell Friends Middle School”; Isiah King, 14 June 2009; flickr.com; 15 Nov. 2010.

The aim of this study was to determine if the completion and opening of this middle school caused any particular changes in the levels of environmentally friendly behavior in the residents of the city of Washington, D.C. Some of the most easily measured and readily accessed information that had the potential to indicate a certain level of influence were recycling records and public transportation records. I felt that each of these sources of information were indicative of the public's convictions and beliefs regarding pro-environmental behaviors, and therefore a significant fluctuation in the data collected may have represented an instance where sustainable design inspired environmentally friendly behavior.

The City of Washington, DC collects recyclable materials from over 100,000 single-family homes. Recycling collection employs a "single-stream" method, in which all recyclable items can be placed in and collected from a single designated container. Washington DC's Department of Public Works provides recycling services free of charge, and in 2005 began providing complimentary recycling containers as part of a citywide recycling program.⁴⁹ As reported by the city of Washington DC's District Department of the Environment, the residential recycling diversion rate for 2004 was 13.60%; for 2005 was 17.10%; for 2006 was 20.61%; for 2007 was 17.02%; and for 2008 was 20.81% (see table 1).⁵⁰

⁴⁹ McGowan, Elizabeth, D.C. Points to Progress in its Struggle to Hit Recycling Goal (Waste & Recycling News, 10 April 2006, 14 Sept. 2011) PDF file.

⁵⁰ Government of the District of Columbia, Public Report on Recycling Fiscal Year 2009 (*District Department of the Environment*, 2008) 4-5. PDF file.

Table 1: Residential Recycling Diversion Rates for Washington, DC, 2005-2007.

Fiscal Year	2004	2005	2006	2007	2008
Residential Recycling Diversion Rate (%)	13.60%	17.10%	20.61%	17.02%	20.81%

Source: Government of the District of Columbia, Public Report on Recycling Fiscal Year 2009 (*District Department of the Environment*, 2008) PDF File.

It seems plausible to believe that the completion and opening of the Sidwell Friends Middle School in September of 2006 may have influenced the recycling diversion rates for the city of Washington, D.C. There was a similar significant increase seen in the 2005 fiscal year, however it can likely be attributed to the government's implementation of the citywide recycling container program.⁵¹ The building's extensive use of recycled materials, natural vegetation and sustainable practices would all have likely been extremely influential in the discovery of one's own convictions and beliefs regarding environmentally friendly behavior. I feel these kinds of influences, whether interpreted as physical, psychological or social as discussed earlier, all contributed to the area's increasing commitment to recycling practices. There is also the possibility that external factors caused the fluctuations seen in Table 1, most notably a major recycling initiative. However, to the best of my knowledge there were no major recycling initiatives being implemented by the city's government during the 2006 fiscal year, which leads me to believe that the design itself of the middle school may have actually influenced and inspired environmentally friendly behavior. Despite this positive

⁵¹ McGowan, Elizabeth, D.C. Points to Progress in its Struggle to Hit Recycling Goal (Waste & Recycling News, 10 April 2006, 14 Sept. 2011) PDF file.

correlation between the city's recycling diversion rates and the opening of the Sidwell Friends Middle School, the following year the city reported a significant drop in the recycling diversion rate, suggesting that the influence the building had was short-lived, however significant. Statistics on the use of public transportation services from the city of Washington, D.C. also provided some significant evidence of the social impact from the completion of the Sidwell Friends Middle School. The Washington Metropolitan Area Transit Authority reported that in 2006, the same year of the completion of the school facility, there were significant increases in the average weekday ridership for both stops that service the area around the middle school. The Metrorail Tenleytown stop, which is located approximately 6/10 of a mile from the school, reportedly experienced an approximately 13% increase in average weekday ridership in the 2006 fiscal year (see table 2). The Metrorail Van Ness UDC stop, which is located approximately 7/10 of a mile from the school, experienced roughly a 5% increase in the same year. Additionally, in the 2007 fiscal year the Washington Metropolitan Area Transit Authority reported that there was roughly a 3.6% increase in ridership for the Van Ness UDC stop, suggesting that there may have been some residual social impact from the school's completion the prior year (see table 3).

Table 2: Tenleytown Stop (0.6 mi.), Washington DC Metrorail, 2004-2008.

Fiscal Year	2004	2005	2006	2007	2008
Metrorail Average Weekday Ridership	6511	6687	7563	7493	7401
Percentage (%) Change	-	2.70	13.10	-0.93	-1.23

Source: Government of the District of Columbia, Metrorail Average Weekday Passenger Boardings (*Washington Metropolitan Area Transit Authority*, 2009) PDF File.

Table 3: Van Ness UDC Stop (0.7 mi.), Washington DC Metrorail, 2004-2008.

Fiscal Year	2004	2005	2006	2007	2008
Metrorail Average Weekday Ridership	6923	7094	7462	7730	7648
Percentage (%) Change	-	2.47	5.19	3.59	-1.06

Source: Government of the District of Columbia, Metrorail Average Weekday Passenger Boardings (*Washington Metropolitan Area Transit Authority*, 2009) PDF File.

Statistics for WMATA's Metrobus also revealed interesting correlations between the average weekday ridership and the completion of the Sidwell Friends Middle School in September 2006. During the year prior to the completion and opening of the middle school, the Metrobus experienced a sharp decrease in average weekday ridership (see table 4). This may have been due to a June 2004 fare increase,⁵² although I cannot be certain. However, the following year the Metrobus experienced roughly a three percent increase in average weekday ridership (see table 4). These same numbers remained

⁵² Government of the District of Columbia, Washington Metropolitan Area Transit Authority: History of Fare Increases (*Washington Metropolitan Area Transit Authority*, 6 Jun. 2011) PDF file.

relatively constant from 2006 through 2008, suggesting that the completion of the Sidwell Friends Middle School may have influenced use of public transportation in the Washington D.C. area.

Table 4: Metrobus Average Weekday Ridership, 2004-2008.

Fiscal Year	2004	2005	2006	2007	2008
Metrobus Average Weekday Ridership	505,000	429,000	442,000	441,000	444,000
Percentage (%) Change	-	-15.05	3.03	-0.23	0.68

Source: Government of the District of Columbia, Metrobus and Metrorail Historical Ridership by Month (*Washington Metropolitan Area Transit Authority*, 4 Mar. 2009) PDF file.

These numbers begin to suggest that the completion and opening of the Sidwell Friends Middle School may have in fact impacted the behavior of the residents of Washington D.C. The school itself was completed and opened in September of 2006;⁵³ a fiscal year in which government agencies reported increases in both residential recycling diversion rates and ridership levels for both the commuter bus and rail lines. And while the population of the District of Columbia has increased substantially over the past ten years,⁵⁴ I do not feel that population variations were the cause of the significant fluctuations seen in the records discussed earlier. Rather, the correlations between middle

⁵³ United States Green Building Council, Project Profile: Sidwell Friends Middle School, Washington, DC (*USGBC*, 2007). 1-2. PDF file.

⁵⁴ Mackun, Paul, and Steven Wilson, Population Distribution and Change: 2000 to 2010 (*United States Census Bureau*, 2011) 1-12. PDF file.

school's date of completion and the data collected suggest that the building may have had an impact on the attitudes and behaviors of the city's residents.

However suggesting these figures may be, I feel I must use caution when extrapolating evidence from these particular case studies. I am no statistician, and I therefore cannot declare with any certainty that these architectural projects are the primary cause of the numbers collected. It would seem quite uninformed to claim that a single building could impact a city's residents' opinions and actions, despite my personal convictions supporting that such an event is possible. However, to the best of my knowledge, there were no significant government sponsored recycling initiatives, public transportation fare hikes or promotional offers that would have likely influenced this data in the years prior to and including the date of the projects' completion.

5.3 Queens Botanical Garden Visitor and Administration Center

The Queens Botanical Garden Administration and Visitor Center located in Queens, NY was designed by BKSK Architects. The building was completed in September of 2007, and was the first public building in New York City to achieve a LEED-Platinum rating from the United States Green Building Council. The building contains an auditorium, reception and gallery spaces, meeting rooms, public restrooms and offices. The design uses a green roof above the auditorium and bioswales to capture and reuse all stormwater. This system is displayed through a water channel, which flows around the building itself and through the surrounding gardens. The structure is oriented along an east-west axis, providing ample daylight for all interior spaces which, when combined with automated lighting systems and operable windows, successfully reduce

the building's overall energy consumption. The building also employs photovoltaic panels, as well as a ground-source heat-pump system to generate energy on site. More than 33% of the building materials were acquired within 500 miles of the site.⁵⁵

The Queens Botanical Garden Administration and Visitor Center is an exceptional example of environmentally sustainable architectural design, which I also feel served as an exemplary case study in my pursuit to establish a relationship between the physical milieu and environmentally friendly behavior. One unique quality of this project that sets it apart from the Sidwell Friends Middle School in Washington, D.C. is that it is entirely open to the public, offering its qualities to a broader range of occupants, and therefore I feel has a broader range of impact. As iterated before, the goal of these studies was to observe correlations between dates of completion of environmentally sustainable buildings, and specific types of environmentally friendly behaviors, most notably public transportation and recycling activities.

⁵⁵ Committee on the Environment, *AIA/COTE Top Ten Green Projects 2008: Queens Botanical Garden Visitor Center* (*American Institute of Architects*, 2008) 1-12. PDF file.



Figure 4: View of the Exterior of Queens Botanical Garden Administration & Visitor Center; “Visitors Center; Queens Botanical Gardens, Flushing, Queens.” Emilio Guerra, 1 May 2010; flickr.com; 15 Nov. 2010.

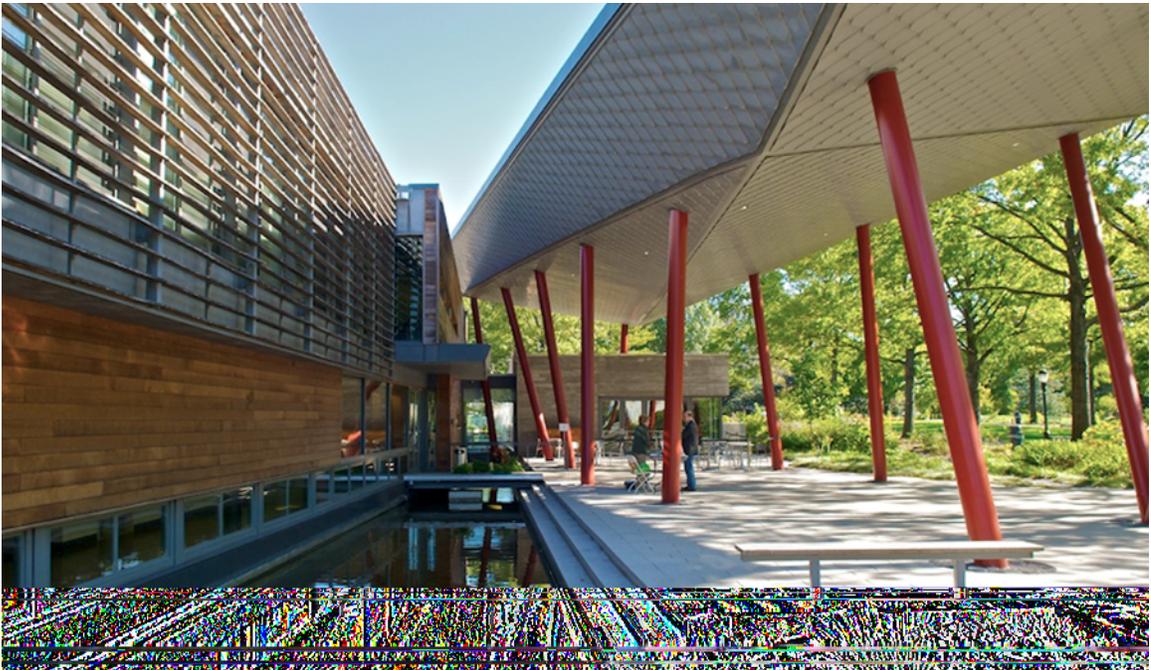


Figure 5: View of the Exterior of Queens Botanical Garden Administration & Visitor Center; “Visitor & Administration Building; Queens Botanical Garden, Flushing, NY.” Thomas Andres, 10 Oct. 2010; flickr.com; 15 Nov. 2010.



Figure 6: View of the Exterior of Queens Botanical Garden Administration & Visitor Center; “Visitors Center; Queens Botanical Gardens, Flushing, Queens.” Emilio Guerra, 1 May 2010; flickr.com; 15 Nov. 2010.

New York City's Department of Sanitation provides recycling at no additional cost, however residents must purchase their own recycling containers.⁵⁶ The total recycling diversion rate as per data provided by the government of the city of New York for 2006 was 31.5%; for 2007 was 32.0%; for 2008 was 35.0%; for 2009 was 32.9%; and for 2010 was 25.6% (see table 5). This increase in the recycling diversion rate, however minimal, possibly displays some of the behavioral effects that the Queens Botanical Garden Visitor and Administration Center's completion had on its community. In the following year of the building's completion, the recycling diversion rate for Queens rose 3.0%, but was immediately followed by a decrease of 2.1% the following year (see table 5). It seems plausible that the increase in the rate of recycling may be attributed to the completion of the Visitor and Administration Center, more specifically the project's use of recycled materials, as well as the program's comprehensive recycling and waste-reduction program.⁵⁷ However, it is also possible that one of the many variables influencing this information is responsible for the shift in the rate of recycling. Fluctuations in population, as well as local recycling initiatives and incentives are each significant factors to consider when interpreting this information. But, to the best of my knowledge, there does not seem to be any outside variable influencing this data. The population of the borough of Queens has increased only slightly from 2000 to present, as

⁵⁶ What to Recycle with Sanitation (nyc.gov, New York City, *Department of Sanitation*, n.d., 10 Nov. 2010)

⁵⁷ Committee on the Environment, AIA/COTE Top Ten Green Projects 2008: Queens Botanical Garden Visitor Center (*American Institute of Architects*, 2008) 9. PDF file.

per estimates provided by the Census Bureau.⁵⁸ To the best of my abilities, I have not been able to find records of major recycling initiatives or incentives that stand out during the years of the building’s construction. Additionally, the city of New York mandates the cleaning and sorting of recyclable materials for all residences, schools, institutions and agencies served by the Department of Sanitation.⁵⁹ Therefore, it seems plausible that the completion of the Queens Botanical Garden Administration and Visitor Center may have influenced the local population’s recycling habits and attitudes regarding such behavior.

Table 5: New York City Total Recycling Diversion Rate, 2006-2009.

Fiscal Year	2006	2007	2008	2009	2010
Total Recycling Diversion Rate (%)	31.5%	32.0%	35.0%	32.9%	25.6%

Source: Government of the City of New York, Mayor’s Management Report Fiscal 2010, (New York: *Mayor’s Office of Operations*, 2010) 128. PDF file.

In addition to residential recycling rates, public transportation records for New York City were also a focus of my attempt to establish a relationship between the physical environment and the behavior of those within. I viewed public transportation ridership numbers as a way of gauging the city’s residents’ general attitudes toward environmentally friendly behavior. For instance, a significant increase in public transportation ridership levels could possibly indicate that public opinion has been

⁵⁸ Department of City Planning, Total Population: New York City and Boroughs, 2000 and 2010 (New York City Department of City Planning, 2011) PDF file.

⁵⁹ What to Recycle with Sanitation (nyc.gov, New York City, *Department of Sanitation*, n.d., 10 Nov. 2010)

swayed, and that more of the city's residents were willing to partake in sustainable practices. What I found in these records were significant correlations between ridership levels and the date of completion of the Queens Botanical Garden Visitor & Administration Center, leading me to believe that the completion and opening of this public project had considerable impact on the attitudes and behaviors of residents local to the area.

In order to more accurately interpret the significant fluctuations seen in the figures above, it was necessary to determine if there had been any significant changes in population throughout the borough of Queens. Theoretically, a significant increase in population could be used to explain the increased ridership experienced by both the bus and subway lines that service the area. However, according to the New York City Department of City Planning, the population in the borough of Queens has increased only slightly; from 2,229,379 in 2000, to 2,230,722 in 2010.⁶⁰ Therefore the increase of bus and subway ridership cannot be entirely attributed to a rise in the local population. Rather it seems plausible that the completion of the Queens Botanical Garden Administration and Visitor Center contributed to the increased use of public transportation in the area.

In addition to population fluxes being an important factor in interpreting these figures, so to was the fare prices of these transportation services. A promotional offer for a discounted fare rate would certainly encourage more people to use these methods of public transportation. However, single ride fare rates for MTA bus and subway remained constant at \$2.00 from May 4th of 2003 through March 25th of 2009. Additionally, the price for a thirty-day subway and bus card was raised \$5.00 to \$81.00 on March 2nd of

⁶⁰ Department of City Planning, Total Population: New York City and Boroughs, 2000 and 2010 (New York City Department of City Planning, 2011) PDF file.

2008.⁶¹ It is interesting to note that despite the price of a thirty-day card rising substantially, there was still a significant increase in MTA bus and subway ridership for the 2008 fiscal year in the borough of Queens (see tables 6 & 7).

Although the Queens Botanical Garden Visitor and Administration Center was completed during the 2007 fiscal year, I feel that much of the effect that the building had can be observed in the 2008 records. The new building was not completed until September of 2007, which did not leave much time for the behavioral effects to be observed during the 2007 fiscal year. In 2008, the MTA reported that there was a 2.26% increase in average weekday bus ridership for routes local to the borough of Queens (see table 6). Also in 2008, it was reported that the average weekday subway ridership for stops in Flushing, Queens had risen by 4.22% (see table 7). Additionally, the MTA noted that it experienced its highest annual subway ridership since 1950, increasing in 2008 by 3.9% through 2007 to over 1.62 billion, in addition to the largest combined bus and subway ridership since 1965.⁶²

Table 6: Total Average Weekday Bus Ridership, Queens Local, 2005-2009.

Fiscal Year	2005	2006	2007	2008	2009
Average Weekday Bus Ridership	371,736	379,203	379,275	387,849	376,209
Percentage (%) Change	-	2.01	0.01	2.26	-3.01

Source: Hickey, Robert, Average Weekday Bus Ridership (MTA, *New York City Transit*, Office of Management & Budget, 18 Feb 2011) Microsoft Excel file.

⁶¹ Associated Press, A History of MTA Fare Hikes (silive.com, *Staten Island NY Local News*, 25 Mar. 2009, 24 June 2011)

⁶² New York City Transit – History and Chronology (mta.info, *Metropolitan Transportation Authority*, n.d., 10 Oct. 2011)

Table 6 (continued): Total Average Weekday Subway Ridership, Flushing, Queens, 2005-2009.

Fiscal Year	2005	2006	2007	2008	2009
Average Weekday Subway Ridership	218,591	225,382	230,523	240,260	234,571
Percentage (%) Change	-	3.11	2.28	4.22	-2.37

Source: Hickey, Robert, Average Weekday Bus Ridership (MTA, *New York City Transit*, Office of Management & Budget, 18 Feb 2011) Microsoft Excel file.

As was the case earlier, I must use caution when trying to determine the cause and nature of the fluctuations seen in the figures discussed above. I hold no degree in statistics, and therefore I cannot be certain that I am accounting for all of the variables that are most certainly involved in these situations. Nevertheless, to the best of my ability I have tried to be as unbiased as possible when collecting and interpreting this data. Despite this, I have still come to believe that the Queens Botanical Garden Administration and Visitor Center had a significant impact on the local residents' attitudes and behavioral patterns. In the year of and the year following the building's completion, records reveal significant positive correlations between these dates and both recycling and public transportation activities. However, these changes in behavior were seemingly short lived, as records show that there were significant decreases in both recycling and public transportation activities in the year following 2008.

CHAPTER 6

CONCLUSION

“In essence, what works of design and architecture talk to us about is the kind of life that would most appropriately unfold within and around them.”⁶³

The initial goal of this paper was to determine what methods and practices of architectural design were best suited to promote and affect environmentally friendly behavior in building occupants. In the earliest stages of my research process, I found very little research on the effects of sustainable design on occupant behavior, and the research I did find focused primarily on the effects of sustainable design on occupant performance and efficiency. By and large in the early stages of my research, my questions remained unanswered. Is the only purpose of the sustainable design movement merely to enhance the performance of its building's occupants? I would hope not. It would seem that the true essence of the sustainability movement would be in the development of a sustainable society; one who's individuals acted and behaved in an environmentally responsible manner. Therefore, it seemed only logical that in an attempt to answer these questions, I would first need to understand the social, psychological, and physical processes that each individual undergoes when experiencing a built environment. In my continued research on these topics, I have found what I believe to be several significant hypotheses that are able to suggest ideas for a built environment that will better promote sustainable human behavior. Although the ideas proposed in this paper are quite tentative, I believe that they may offer some insight into the role of the built environment in influencing behavior.

⁶³ De, Botton A., The Architecture of Happiness 72.

In my research and analysis presented in this paper, I feel as though I have only scratched the surface of a very complex, multi-disciplinary social issue, and I urge the continued study of this topic so that we, as a society, may progress toward a sustainable revolution that is practiced not only by members of the design professions, but also by the people that occupy those designs. It is not my intention to develop some kind of a standard architectural design that can guarantee behavior change. Rather, it is to more adequately understand the social, psychological and physical influences of the built environment on the individual so that all members of the design professions may be able to more effectively inspire and affect environmentally friendly behavior. I feel the topics discussed in this paper offer insight into the possible roles that architectural design can play, and I hope them to be the groundwork for future research on the effects of sustainable design on social attitudes and behaviors.

During this investigation, the topic of regulation was also brought up on numerous occasions as a means of promoting and affecting environmentally sustainable behavior. This seems to be a plausible idea, considering that our everyday lives are constantly regulated, and for the most part, we generally conform to these regulations. However, there are many instances when enforcement may breed a kind of resentment, resulting in those who will disobey regulation, not because they have any particular objection to its desired effects, but simply because they are being told to do so. Amos Rapoport writes, "To consider merely communication, in the present situation cues may not be noticed, if noticed they may not be understood; if both noticed and understood

some users may refuse to conform.”⁶⁴ Employing such an active method of behavioral control may have unintended consequences, possibly resulting in complete defiance of the attempted regulation. Therefore it was a preference of mine to research only passive methods that would attempt to inspire and affect environmentally sustainable behavior.

I hold the conviction that the ultimate goal of the sustainability movement in the design fields is to inspire a society that extensively practices environmentally sustainable behaviors. If this is true, then it is essential to understand the cognitive processes that each individual undergoes when set in an artificial environment, so that we may begin to comprehend how each of us interpret and react to certain design elements. It is my hope that in the pursuit of this understanding, we will be able to develop a model of behavioral patterns to be employed in the built environment in order to affect environmentally sustainable activity and behavior.

⁶⁴ Rapoport, Amos, On the Cultural Responsiveness of Architecture (*Journal of Architectural Education*, 25 (1987): 287-8).

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