Are Windows and Views *Really* Better?
A Quantitative Analysis of the Economic and Psychological Value of Views

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January 2005

Funding for this project is supported by the Daylight Dividend Program of the Lighting Research Center, Rensselaer Polytechniqic Institute.

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1 Introduction

The idea is familiar that view matters. Most would agree that a room with a sunny window overlooking a lake is preferable to one with concrete walls in the basement. Indeed, views and windows may add psychological value, with rooms lacking a view to the outdoors feeling more claustrophobic and depressing than a room with a view. Views and windows may also add economic value, with property overlooking a beautiful landscape costing more to rent or own compared to property without a desirable view.

Past research supports this notion that view is important, with studies finding a direct relationship between higher satisfaction about a view in an office building and increased work productivity. For example, in her article titled "Enhance User Satisfaction, Performance with Daylight," Sims (2002) suggests that quality views provide significant psychological advantages for workers. She claims that scientists, if asked to rate what they value most in the lab, would respond "windows." She adds that some of the more archaic lab designs are characterized by well-lit offices around the perimeters, and dark, windowless labs on the interior. By doing so, a number of negative consequences result: employees begin to lack a clear sense of orientation, less revitalization of the spirit occurs when missing views of landscape or warmth from the sun, and employees miss the opportunity to bear witness to outdoor activities (Sims, 2002).

In the article, "Redesigning the Office Space," Archie Kaplen (1975) discusses the need for a welcoming relationship between the office environment and outside world. Characteristics of a corporation's office environment convey certain messages about its identity and philosophies. Accordingly, by having an open, spacious, flowing floor plan with plenty of windows and quality views, a corporation communicates to its employees that its business practices and interpersonal philosophies are also open and inviting, ultimately leading to the generation of positive feelings among these employees.

One celebrated building design that provides evidence for increased work productivity in areas with better views is the 'iwin.com' office in Los Angeles. The unit, which is located on the tenth and eleventh floors of "The Tower," was mostly interested in moving away from the trend of preserving offices with better views for corporate partners of the business. One way they approached this challenge was to free up the rooms with more interesting views by placing all of the conference rooms, copy areas, and other office necessities on the interior of the offices, and assigning the lounges, offices, and other social areas to the exterior of the building where light and magnificent views add to the positive atmosphere. This project, along with many others like it, involved arranging entire building designs around maximization of quality views to enhance employee satisfaction, thus exemplifying the value of a view.

Recently, alternative measures to office re-design, have been developed in an attempt to improve quality of view and employee productivity. The lighting company Bio-Brite, for example, manufactures an artificial, electrically lit window available for business owners (Wechsler, P., Kerwin, K., Arnst, C., 1997). The window display costs $150 and the backlit design can easily change displays with the flip of a switch from a golf course, to an English garden, to a tropical beach scene (Wechsler, P. et al., 1997). These windows can even enlarge and display a picture brought in by a staff member. This phenomenon, that artificially created devices imitating the benefits of a view have even been developed and sold, supports the idea that views have economic market value.

Views may not, however, *always* add desirability. In fact, windows and openness can be undesirable. For example, though large windows with their views to the outdoors are generally considered assets in buildings, large windows are associated with several thermal and visual liabilities such as solar heat gain during the day, heat loss at night in winter, and more importantly, glare that can cause both visual disability and discomfort. Even in the absence of sunlight, excessive skylight (diffused illumination from the sky) entering through a large window can cause visual discomfort or eye fatigue.

Further, spaces with little or no enclosures can create a barren feeling. Some degree of enclosure creates a sense of protection and security, a psychological comfort. We have often observed that children enjoy hiding in enclosed spaces such as a long-narrow tunnel in the playground, a dark closet, or under a table. Places with excess space and open view may fail to provide this sense of security and protection.

Though evidence supporting the value of views and windows exists, most studies documenting such evidence have been primarily experiential or qualitative. Very little research has empirically examined the value of a view in quantitative terms.

As such, the goals of this project were to quantify and document the financial and psychological values of windows and outdoor views. The first part of this project ("Section 2") tested the idea that better views are associated with higher economic value. We examined data from hotels, residential spaces, and office buildings in several city locations to assess whether view was associated with cost. The second part ("Section 3") aimed to quantify the psychological value of views and windows, as measured by peoples' seat selection patterns and preference to situate themselves near favorable views and windows.

2 Economic Value of Views and Windows

The first part of this project was conducted with the goal of quantifying the relationship of views in a building to economic value. Two studies were performed to test this hypothesis. First, data from the 2002 BOMA (Building Owner and Managers Association) Experience Exchange Report was analyzed to assess whether buildings with better views (as defined by taller height and subsequent access to improved skyline and cityscape views) have higher property value. Second, survey data was collected in hotels, residential spaces, and office buildings in several city locations, to measure whether spaces in these buildings with better views generated higher rental income. Through these two studies, we expected to find that the assigned cost structure of a building or a space in a building increased according to the desirability of its view.

A further goal of Section 2 sought to examine the relationship of cost to view, by looking at the type of building. We hypothesized that the extent to which rental cost is related to quality of view would vary depending on the type of business conducted in the building. For example, because business hotels rent on a temporary basis to clientele that may not need or have time to enjoy a view, rental cost of a room may not increase according to improved view. On the other hand, residential and office buildings are more permanent and essential places in people lives, and therefore may have a stronger relationship between assigned economic value and quality of view.

2.1 Analysis of BOMA Building Property and Rental Value Data

The 2002 BOMA Experience Exchange Report lists data regarding characteristics and properties of buildings such as year of erection, number of stories, and estimated property and rental value. This study conducted a secondary analysis on the 2002 BOMA data, using the following variables: 1) availability and quality of view, as defined by taller height and subsequent access to improved skyline and cityscape views; 2) rental cost of the building, measured in dollars per square foot; and 3) age of the building, measured in years. The relationship between view, or height of the building, and rental cost, was plotted separately for each decade-long range of building age. Hypotheses were that a building's height, or availability of view, is related to increased cost of the property.

Overall, graphical representations of the relationship between building height and cost for each decade of building age (See Figures 1-6 below) show a general upward slope, indicating that buildings with a large number of floors and therefore greater availability of view cost more to rent, per square foot, than do buildings with fewer floors.

On closer observation beyond this general trend, we see that the positive relationship between view and cost is more modest, less clear, for the youngest (ages 0-9 years in Figure 1) and oldest buildings (ages 50+ years in Figure 6). In particular, rental cost actually decreases slightly for buildings consisting of 10-39 floors. A dramatic increase in cost occurs for buildings of 40 floors and higher. It is this increase that largely accounts for the general upward trends observed in data for young and old buildings. Several reasons may account for these interesting findings. In city environments where buildings are dense and close to each other, lower floors do not provide the benefit of an outdoor view. Instead, these lower floors have windows overlooking adjacent buildings. Only the higher floors, such as floor 40 or higher, provide height above other buildings to allow access to expansive views. These height and view considerations may account for the higher rental costs for buildings of 40 or more stories.

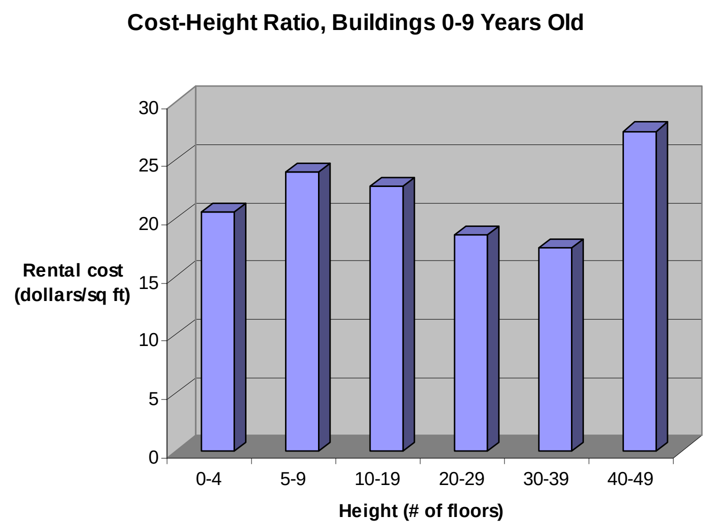


Figure 1: Cost-to-Height comparison (0-9 Years of Age)
This figure depicts only a modest upward trend of cost-to-height ratio. The horizontal axis represents the variable "Height in Floors" while the vertical axis represents the variable "Dollars per Square Feet."

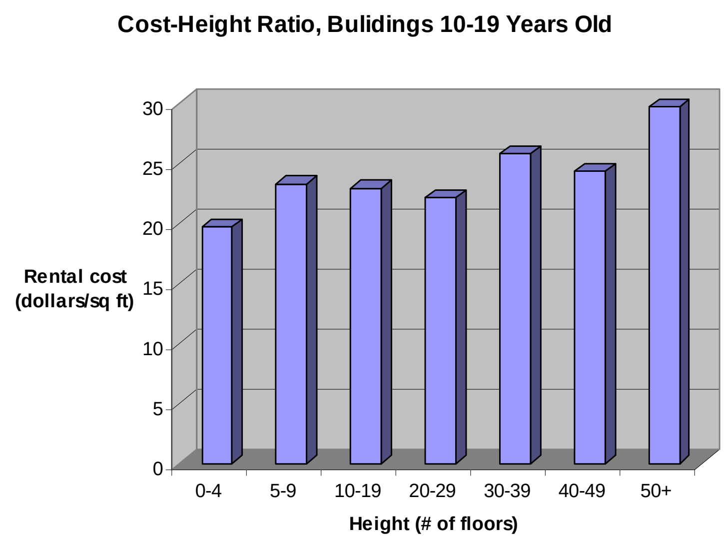


Figure 2: Cost-to-Height comparison (10-19 Years of Age)
This figure again depicts an upward trend of cost-to-height ratio. This chart more reliably indicates a relationship between better views and higher costs.

Figure 3: Cost-to-Height comparison (20-29 Years of Age)
This figure shows an increased value for office units with higher floors. Again, this correlation seems to support the hypothesis that views are taken into account when pricing office rental units.

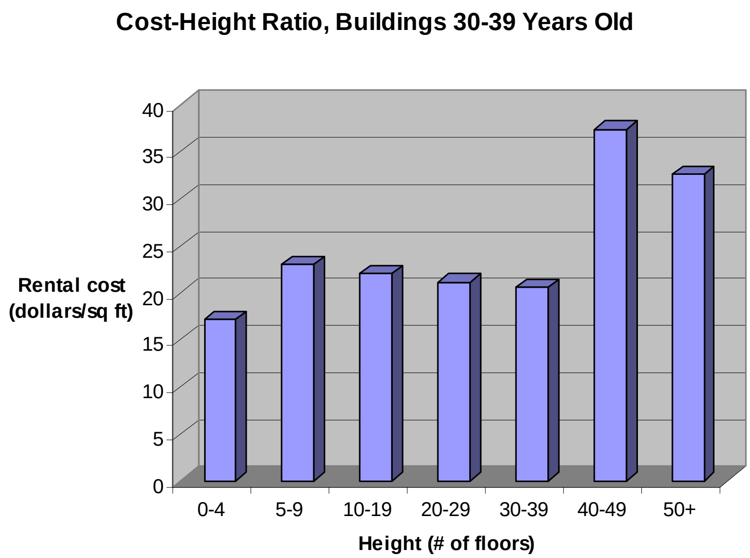


Figure 4: Cost-to-Height comparison (30-39 Years of Age)
This figure also depicts an upward trend of cost-to-height ratio. There is an average $20 difference in monthly rental costs between buildings with the lowest and highest number of floors.

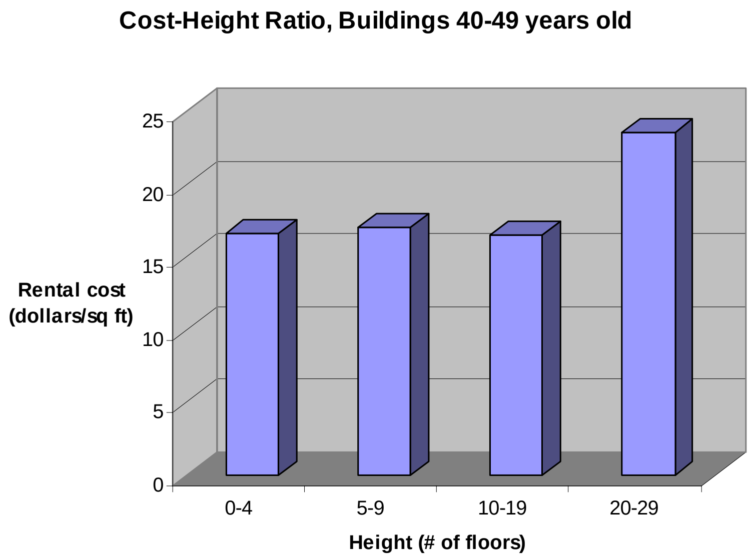


Figure 5: Cost-to-Height comparison (40-49 Years of Age)
This figure also depicts an upward trend of cost-to-height ratio. Although the correlation is not as clear as in the previous table, an approximate $10 per month cost differentiation exists between buildings with the lowest and highest number of floors. .

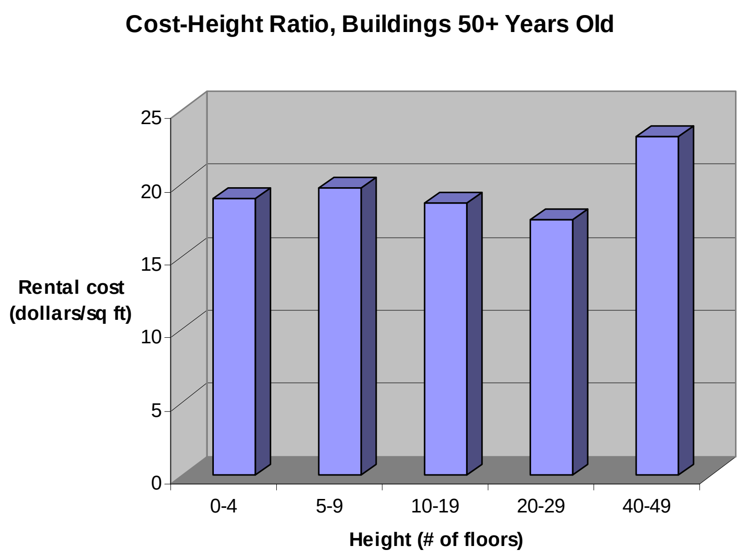


Figure 6: Cost-to-Height comparison (Age 50 years or more)
This chart, like the data for youngest buildings 0-9 years of age, shows only a modest relationship between height and cost. Any positive relationship is largely accounted for by the increase in cost for buildings 40 floors and higher.

2.2 Survey of Hotels, Office, and Residential Buildings: Assigned Economic Value Based on View

2.2.1 Method

This study polled managers at 21 hotels, 15 residential buildings (e.g., condominiums and apartment complexes), and 22 office buildings from the Los Angeles, Chicago, and New York areas. These cities are recorded to be among the three most expensive cities in the country, and thus were chosen to ensure the availability of a range of rental property cost and data related to large buildings. Hotels, residential buildings, and office buildings were contacted based on their online user rating (such as the star-rating system for hotels), the height of the buildings, and the range of costs between units within the same building. Hotels were only surveyed if they had a four or five star rating, residential buildings only if they were high rise or boasted magnificent views, and office buildings also only if they were high-rise. Additionally, because preliminary data analyses indicated that hotels without good views would logically decide not to take view into account when pricing their units, efforts were made to poll hotels located in areas where good views were available.

When a unit was reached, our researchers asked for the shift manager and used the following standardized script: "Hello, I am a researcher with the University Of Michigan Taubman College Of Architecture and Urban Planning, and we are conducting a study to determine if better views in rental units increase their cost. We were wondering if you could tell us if better views generate higher costs in your hotel/apartment complex/office building." The participant would simply respond with a "yes" or "no" answer. Qualitative data regarding pricing policies of each business were also recorded. Based on past research, hypotheses were that price differentiation of spaces within these buildings would vary according to view, thus supporting the general research goal of quantifying a relationship between view and economic value. To test these hypotheses, one sample t-test calculations were performed. Given that a null relationship between view and price would yield an equal likelihood for a "yes" or "no" response, the percentage of positive responses obtained for hotels, residential buildings, office buildings, and all buildings aggregated were compared to the random chance or equal likelihood (50%) of a "yes" response. A significant t-test result would indicate that the percentage of "yes" responses was greater than chance, or that price is related to view.

To address the second goal of this research project, the percentage of "yes" answers (indicating that price varied according to view) were compared between the hotel, residential, and office businesses. We expected that the extent to which rental cost is related to quality of view would vary depending on the type of business conducted in the building, with residential and office buildings showing a significant relationship between economic value and view, but hotel buildings showing no relationship between price and view.

2.2.2 Results

Hotels

Of the seven hotels polled in each area of Chicago, Los Angeles, and New York City, three in Chicago, four in Los Angeles, and three in New York City indicated a "yes" response, that views were a variable in pricing their rooms. In total, of the 21 hotels polled, less than half (10 out of 21, or 47.6%) indicated that pricing structure varied according to view (see Table 1). A one-sample t-test calculation yielded an insignificant result, refuting the overall hypothesis that price varies according to view.

Qualitative data showed that among the 10 hotels indicating that views were a factor in pricing, price differences between rooms with better versus worse views ranged from $15 to $70. Several of the hotels that reported a "no" response elaborated to describe reasons why view was not taken into account. The most common reasons included a lack of variation in view. Because rooms were similar in quality of view, managers were unable to differentiate price based on view. Conversely, when the views varied *too much*, with too many different kinds of views available, price structure was also dissociated from view. Instead, these hotels set their room rates based on a variety of other factors, including the type of room, amenities or privileges available, and occupancy, with prices increasing as a hotel neared capacity. Pricing also varied if there were important events going on in the surrounding city (e.g., parades), or if competition with comparable hotels forced them to provide matched or lower rates so as to attract customers. Often, for these hotels, rooms with better views were simply assigned on a first-come first-serve basis.

Residential Buildings: Apartments and Condominiums

Of the five residential buildings polled in each area of Chicago, Los Angeles, and New York City, four in Chicago, four in Los Angeles, and five in New York City indicated a "yes" response, that views were a variable in pricing their units. In total, of the 15 residential buildings polled, an overwhelming majority (13 out of 15, or 86.7%) indicated that their units were priced according to view (see Table 1). A one-sample t-test calculation yielded a significant result, supporting the overall hypothesis that price varies according to view ($t_{14} = 4.86$, $p<.001$).

All buildings surveyed were high-rise in structure, thus providing the potential for better views of the cities and their skylines from higher floors. Most buildings reported that though price was indeed related to view, there was no reportable standard rate of increase for units with better compared to worse views. One condominium in New York reported a price difference ranging from $15,000 to $25,000 depending on their unit orientation and view, and another reported that price increased a standard amount with each floor level.

Office Buildings

Because the original research question focused on and was inspired by an office setting, the sample size of office buildings polled was slightly larger and more varied compared to that of hotels and residential buildings. The tallest office buildings in each city were contacted, totaling seven in Chicago, six in Los Angeles, and nine in New York City. Six of seven in Chicago, three of six in Los Angles, and seven of nine in New York City reported varying their leasing prices according to view. In total, a majority, over two-thirds (16 out of 22, or 72.7%), of office buildings surveyed indicated that price and view were related (See Table 1). A one-sample t-test calculation yielded a significant result, supporting the overall hypothesis that price varies according to view (t_{21} = 2.080, $p<.05$).

Table 1: Percentage of buildings taking view into account when determining price structure

Type of Building	Percent "Yes" (view was a factor in price structure)	Percent "No" (view was *not* a factor in price structure)
Hotels (N = 21)	47.6%	52.4%
Residential (N = 15)	86.7%***	13.3%
Office (N = 22)	72.7%*	27.3%
OVERALL (N = 58)	67.2%**	32.8%

Note: Percentages with asterisks were found to be significantly different than 50%. *p< .05. **p< .01. ***p< .001.

Cumulative Analysis

Overall, out of the 58 hotels, residential buildings, and office buildings polled, over two-thirds (39 of 58, or 67.2%) answered "yes," that they did take view into account when pricing the units in their property (See Table 1). To determine if this percentage of positive responses is significantly different than the than the possibility that view and price are not related (which would yield a random or equal (50%) likelihood of a "yes" or "no" response), a one sample t-test calculation was performed. Results supported the hypothesis that a statistically significant number of buildings reported views to be a factor in pricing (t_{57} = 2.80, $p<.01$).

Variation according to type of building

Examination of the t-test analyses show that for hotels, view was not significantly related to price, whereas for residential buildings and office buildings, view did significantly determine price structure (See Table 1). These findings support the hypothesis that the extent to which rental cost is related to quality of view varies depending on the type of business conducted in the building,

2.2.3 Discussion

The analysis of data from the 2002 BOMA Experience Exchange Report showed an upward positive relationship between number of floors in a building (a proxy measure of view) and the assigned property value. In a second study, hotels, residential buildings, and office buildings were polled to determine what percentage of the businesses assigned rental price of their units according to the existence of a better view. Overall findings showed that a significant number of buildings surveyed did consider view when pricing their units. These results confirm the idea that views have economic value.

Further analysis of responses from each different type of business (hotels, residential, and office) revealed that the relationship of view to economic value varies depending on the type of business conducted in the building. Specifically, residential and office buildings took view into account when determining price structure, while hotels did not. Several reasons may account for this difference. For example, because hotel accommodations are temporary by nature, customers may not care as much about a view or consider view when forming an opinion or rating of the hotel on a long term basis. Residential and office buildings, on the other hand, are a more permanent fixture in people's lives, with residents frequenting the space on a more regular basis. Thus, people may value the psychological and interpersonal benefits of a view more highly when assigning price or making a choice about which unit to rent. These more permanent residents may associate higher economic value with the increased privacy higher floors with better views afford in a residential space, or the positive feelings windows and views provide in an office space.

Our results confirm that the economic value of a view varies according to the type of business conducted in a particular building, thus pointing to the possibility that other factors besides type of building may also be important as well. In addition, age, structure, design, and location are possible variables that may also affect the economic value of a view, and should therefore be explored in future studies.

3 Value of Views and Windows as Measured by Seating Preference

The second part of this project was conducted with goals of quantifying the relationship of views and windows to psychological value as measured by peoples' preference to situate themselves near to or away from favorable views and windows. To test this hypothesis, we recorded the seat selection patterns of occupants in two types of settings: social (a cafeteria) and workplace (a library study area). Occupancy at workstations and tables near windows (and an outdoor view) versus away from windows was compared. We expected to find that seating occupancy would be higher in areas near windows and outdoor views compared to areas closer to the interior without views and windows.

3.1 Test Space Selection

In this study, data regarding seating selection patterns were collected at two locations: The University of Michigan North Campus Cafeteria and the University of Michigan Taubman Medical Library. Several criteria were used to select these test locations, including size, function, and spatial layout. First, a large number of available seats were needed to collect a reliable sample. Second, in order to collect data representative of different types of functional spaces, areas used for primarily social purposes (the cafeteria) versus primarily work purposes (the library) were chosen. Finally, to test hypotheses that seat selection is related to the availability of views and windows, each space was required to have clear differentiation between areas with and without available outdoor views and windows. Below are descriptions of the test spaces chosen.

University of Michigan North-Campus Cafeteria

The cafeteria dining area has approximately 50 tables with 196 seats, and is elongated along the north-south axis with large curtain-wall windows facing the west. These windows overlook a natural outdoor setting of a forest on rolling hills. Lining the East and most of the South and North sides are interior walls with no windows leading to outdoor views. Four rows of tables are set up in parallel, with the three interior rows seating parties of four and the exterior row seating parties of six (See Figure 7).

The cafeteria style of service has patrons entering the dining area at the northwest side of the restaurant and immediately taking a left to join a food line located at the far interior seating section. Patrons must pass three rows of interior and middle-interior tables to reach the tables adjacent to the windows. The cafeteria is open from 11:30am to 2pm. A diner in this cafeteria can freely take any seat in the room, with the exception of reserved seats, which appear only occasionally. During early time periods (11:30am to noon), occupancy is low with many seats available. Accordingly, a patron has many more empty seats to choose from, and can generally choose any desired seat at any location in the room. Because of these architectural and operational features, the dining room is ideal for observing how a person selects a seat in relation to windows and views.

(a) (b) (c) (d) (e) (f)

Figure 7: Interior Views of North Campus Cafeteria.
(a) view from entrance; (b) view from cashier; (c) area near south window; (d) area near north window; (e) area near south-west windows; (f) area near north west windows.

The dining room is a large open hall. No partitions obstruct views to the windows from any seat in the room. Based on proximity to the windows, we divided the room into two zones, with the first two rows of tables closest to the windows labeled the “view” area and the third to fourth rows towards the interior labeled the “no-view” zone.

University of Michigan Taubman Medical Library

The second location studied was the Taubman Medical Library on the University of Michigan medical campus. The library reading area has 48 tables with 200 seats, is a rectangular shape elongated along the north-south axis. Strip-windows line the north side of the room and provide views of the open sky and a nearby building. A courtyard can be seen below from a position two or three feet away from the windows, but is occluded when sitting at the desks. Clerestory windows run the southern 4/5th length of the west wall, and provide views of a brick wall and windows from an immediately adjacent building. No sky or open views can be seen though the clerestory windows. The south wall is enclosed by administrative office space (See Figure 8).

As a patron enters the medical library they walk westerly, through the library information and check-out desks, directly into the reading room. The room is divided into three sections: one directly by the windows on the north side, one far-interior section on the south side, and one section in the middle-interior. Upon entering the reading area, the mid-interior set of tables is directly in front and is closest. Going past the mid-interior tables, the patron can just as easily choose to go south with no window view or north with a window view. All tables run parallel to the windows and seat four people.

A set of book stacks run side-by-side along the east-west axis of the reading area at a line 24 feet deep from the north windows. The book stacks partition the reading area into two areas: a) a small north area with open views through the north windows and b) a large south area enclosed by mostly walls, with the exception of obstructed views of an adjacent wall through the clerestory windows. Based on this differentiation of availability and quality of views, in this study, we divided the reading area into two zones, and referred the north area as the “view” area and the south as the “no-view” area.

3.2 Data Collection Procedure

A series of observations, recordings and measurements were made over 6 different days (May 27 and June 3, 4, 11, 16, 18 of 2004) at the cafeteria and 8 days (October 5, 6, 26 and November 3, 8, 10, 17, 22 of 2004) at the library. Observations at the Taubman Medical Library took place from either 9:00am to 12:00pm or 2:30pm to 5:30pm, whereas data at the North Campus cafeteria was collected from 11:30am to 1:00pm. These data collection days and times were chosen, taking into account optimal number of occupants and weather conditions. For instance, we did not collect data in the Taubman Medical Library during summer recess, because not enough occupants would be present in the reading area. Additionally, on a cloudy day, outdoor views are less desirable and would be less of a factor in peoples’ seat selection. On a sunny day,

(a)

(b)

(c)

(d)

(e)

(f)

Figure 8: Interior Views of Taubman Medical Library.
(a) entrance to the library; (b) area near north windows; (c) exterior view through north windows; (d) mid-interior area; (e) far-interior area; (f) mid-interior area near west windows.

However, outdoor views are more attractive and would be considered a more salient factor. Accordingly, it was necessary to collect data on both sunny days and cloudy days.

Two sets of data were recorded: 1) measurement of environmental conditions in the test space, including temperature, light level, and humidity and 2) recordings of seat occupancy over time. Seat occupancy data were recorded by a team of researchers. In order to minimize subjects' awareness of this study, the recording team camouflaged themselves as diners or students studying and stationed themselves in a remote and unobtrusive areas of the test space.

Both the cafeteria and library areas were divided by an imaginary set of grid lines according to proximity to windows and outdoor views. In the cafeteria, there were 107 possible "view" seats and 89 "no-view" seats. In the library, there were 64 "view" seats and 136 "no-view" seats available. In each grid element of "view" or "no-view" areas, we recorded which seats were occupied and which were empty, over a time series of every 10 minutes in the cafeteria and every 30 minutes in the library. This seating density data was mapped on a floor plan with a number of dots, each dot representing one person seated. Such a seat-selection mapping method would reveal how occupants select their seats with respect to windows and views. Using this data, a comparison was made between occupancy rates in "view" compared to "no-view" areas to quantify the impact of windows and views on seating preference.

The measurements of temperature, light levels (from the combination of both daylight and electrical indoor light), and humidity were recorded for purposes of assessing whether such environmental conditions may have accounted for any observed seat selection preferences beyond the influence of available windows and views. Three Hobo U2 meters were placed at three different locations in each test space: by the window, in the middle of the room, and in the interior of the room furthest from the window.

Environmental data were collected for 6 days (May 27, June 3, 4, 11, 16, and 18 of 2004) in the cafeteria and 3 days (October 5, 6 and 26 of 2004) in the library. Prior to field measurements, calibration tests were performed on each meter to show that under the same conditions, all three meters gave identical, accurate output readings.

3.3 Temperature, Light Levels and Humidity in Test Spaces

Graphical representations of temperature, light levels, and humidity as a function of location and time show whether there are any notable differences in these environmental conditions. Readings were compared across sections of the test spaces (window, middle, and inside) to determine if differing environmental conditions may have factored into the desirability of a particular section.

University of Michigan North Campus Cafeteria

Below are example graphs of temperature, humidity, and light intensity readings taken at the cafeteria on May 27, 2004 (Figures 9, 10, and 11). Data from this day of observation are generally representative of trends seen on other days. Appendix A1 contains graphical representations of environmental readings from other days of observation.

For the most part, temperature levels at the North Campus Cafeteria were steady and similar across all sections, with only slight variations in the window section higher or lower than the middle and interior sections by a maximum of 2 degrees. Overall temperature of the room regardless of section, however, varied from day to day, with the lowest reading of 67°F on June 11th and the highest of 75°F on June 16th. One pattern noticeable on all measurement days was that when the cafeteria was just opening (11:30am – noon), temperature levels decreased with time (See Appendix A1-3). This probably is because the room was not air-conditioned when not occupied, and that air-conditioners were turned on only right before the opening.

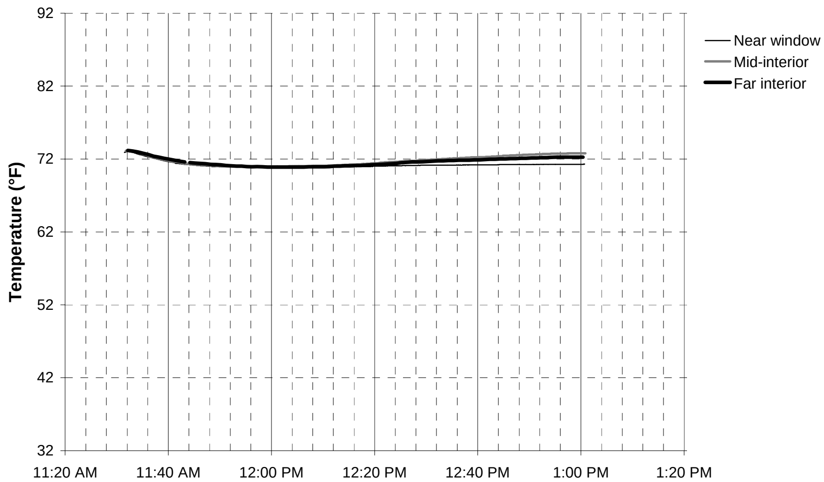


Figure 9: Temperature at the North Campus Cafeteria for May 27, 2004

Relative humidity readings varied between days and according to the outdoor weather, with levels ranging from 30-65% (see Figure 8). However, for the most part, humidity readings between all three sections (window, middle, and interior) on any particular day were uniform, though in a few instances, relative humidity was lower by the window compared to the interior. Even the most extreme case on June 16th, however, showed a relatively minor difference with humidity levels at the window 8% lower than readings taken at the interior (see Appendix A1-5). Contrary to temperature, humidity levels drastically increased during the early minutes of the cafeteria opening (11:30am – noon). The moisture produced by the occupants, kitchen and foods would have contributed to such increases.

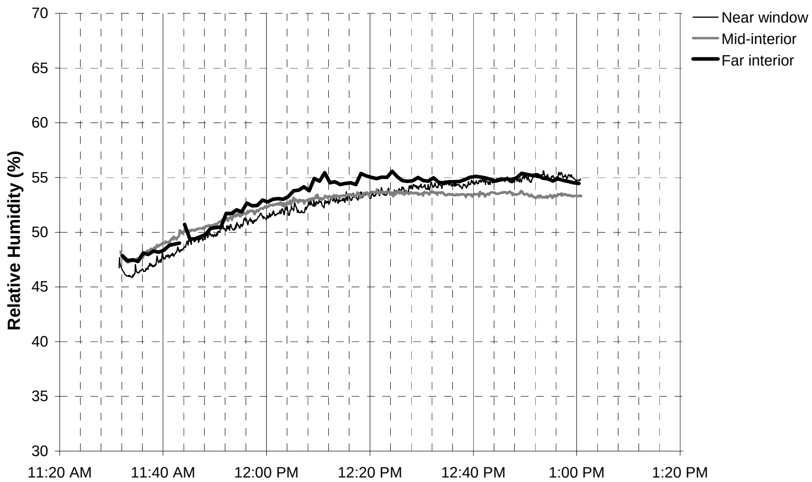


Figure 10: Relative Humidity at North Campus Cafeteria for May 27, 2004

Light levels at the middle and inside positions were steady over time, though 60-80 foot-candles apart, with the interior section having lower light levels (see Figure 11). Specifically, the interior section had light levels ranging from between 30 lumens on June 11th to 50 lumens on June 4th, whereas the middle section ranged from 95 lumens on June 11th to 130 lumens on June 4th (See Appendix A1-3). The window section was much more variable, and mostly showed much higher light level readings compared to the middle and interior sections. At its highest, window readings were at 290 lumens on June 16th (See Appendix A1-5). The fluctuations of the light levels in the window section are due primarily to changing sky conditions and available daylight. Particularly, daylight levels are most variable on partly cloudy days, with sunlight scattered and reflected by patches of moving clouds.

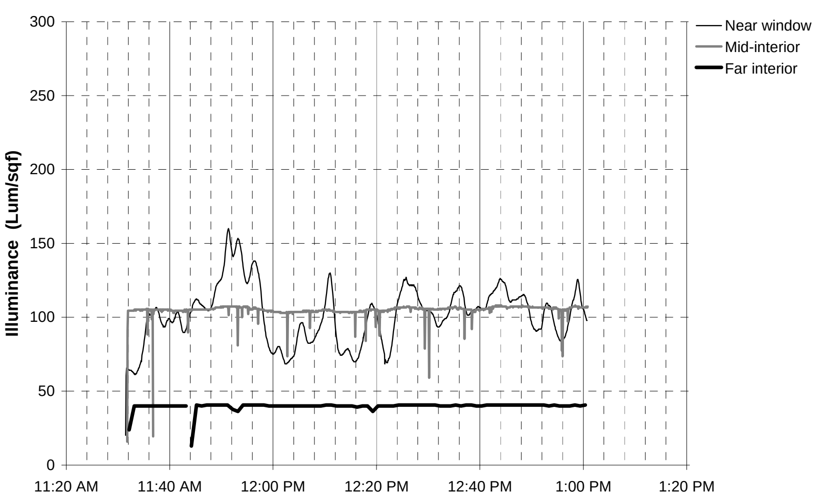


Figure 11: Illuminance at North Campus Cafeteria for May 27, 2004

University of Michigan Taubman Medical Library

Temperature levels at the Taubman Medical Library were extremely steady and uniform hovering around 74°(F) on all three days in all sections (window, middle, and inside) of the study (See Figure 12). On October 6th and 26th, the temperature was only slightly higher in the window section by about 1 or 2 degrees (See Appendix A2). No noticeable spatial or temporal variations of temperature levels were observed within the library on all measurement periods.

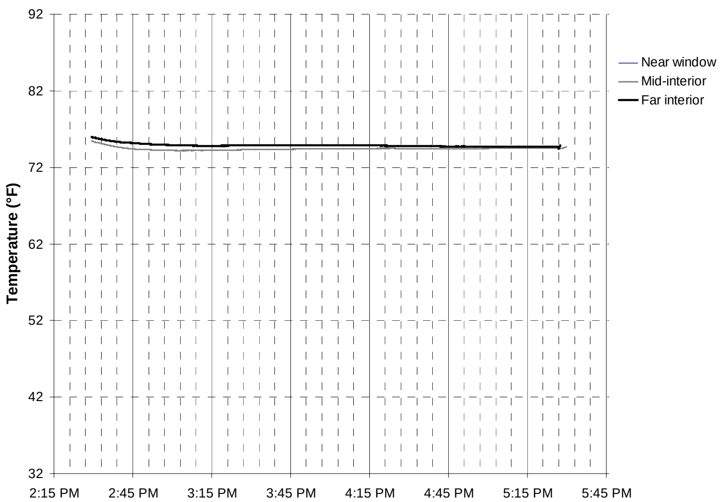


Figure 12: Temperature at Taubman Medical Library for October 5, 2004

Relative humidity readings varied between days and according to the outdoor weather, with levels ranging from 20-40%. Most importantly, however, humidity readings between all three sections (window, middle, and interior) on any particular day were nearly identical (See Figure 13).

Light levels in the mid-interior and interior sections were very constant at just over 100 foot-candles for all three days (See Figure 14). Exceptions were October 26th, when the far-interior section showed particularly low lighting level at 70 foot-candles. The window section, on the other hand, showed higher light level readings and generally more variability than the interior sections. For example, on October 6th and 26th, the window light level was the highest and most variable at 120-130 foot-candles.

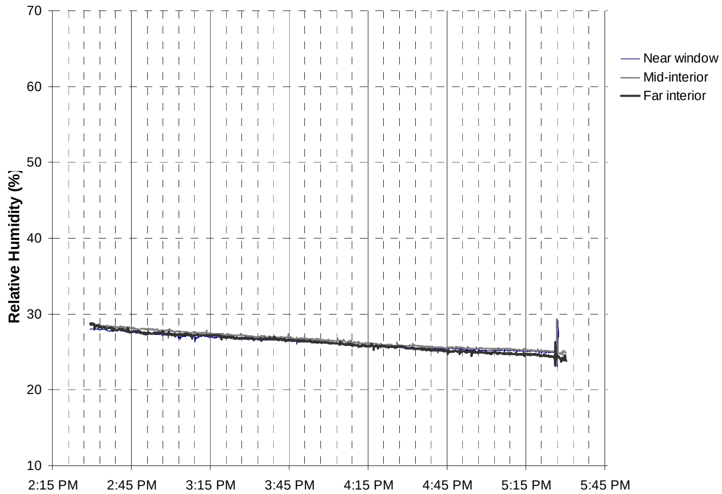


Figure 13: Relative Humidity at Taubman Medical Library for October 5, 2004

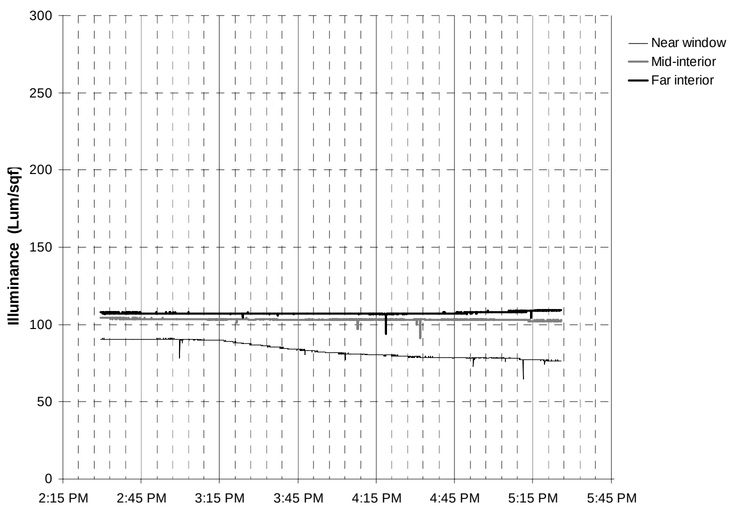


Figure 14: Illuminance at Taubman Medical Library for October 5, 2004

Overall, temperature and relative humidity readings in both the library and cafeteria were similar for "view" areas (i.e. the window section) compared to "no-view" or interior areas. With this data, we can reasonably conclude that any seating choices made by the library's and cafeteria's occupants were not made according to variability in humidity or temperature. Light levels, however, were higher and more variable for windowed "view" areas compared to "no-view" areas. These differences in light intensity may have mediated any observed differences in seating occupancy between "view" and "no-view" areas. In other words, the benefits of luminous natural light associated with windows and views may influence occupants to choose these "view" areas.

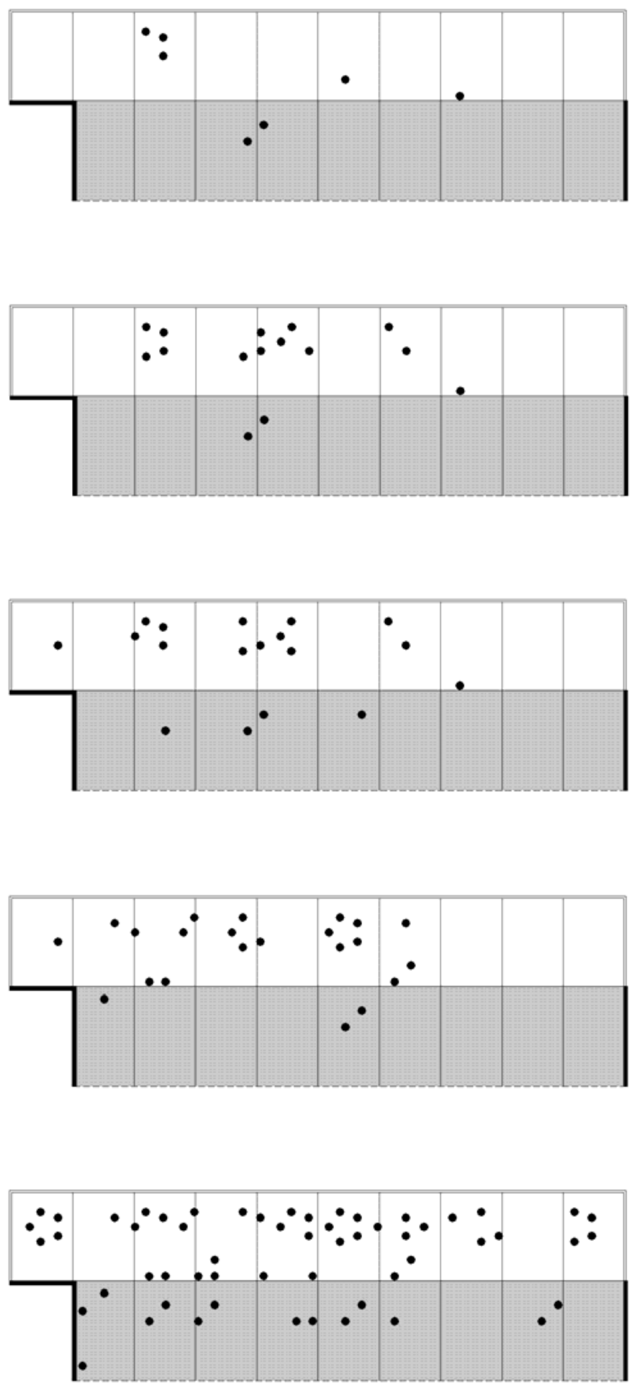
3.4 Seat Selection Patterns

3.4.1 North Campus Cafeteria

Below is an example of two-dimensional seat selection mappings over a period of six 10-minute time intervals on May 27, 2004 at the University of Michigan North Campus Cafeteria. Figures 15 and 16 show time-series interior views and two-dimensional mapping of seat selection patterns. Data from this day of observation are generally representative of trends seen on other days of observation (See Appendix C1 for seat selection mappings from other days of observation). Perusal of the occupancy progression on May 27 show a general trend of high density in “view” areas near the window during times when less people are present and more seats are available to choose from. In other words, seats closer to the window seem to fill up first. As time progresses and more people arrive to the cafeteria, less “view” seats are available, and seating density is more evenly spread between the “view” areas and “no-view” interior areas. Thus, at first glance, these data seem to support hypotheses that people prefer and assign more value to seating locations near windows and views.

Figure 15: Time Series Interior Views of North Campus Cafeteria from 11:30am – 12:30pm at every 20-minute interval on May 27, 2004 (left to right, top to bottom)

Figure 16-a: 2-Dimensional Mapping of Cafeteria Occupancy (May 27, 2004).



11:30 am

11:40 am

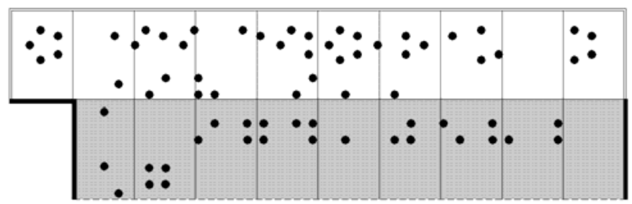
11:50 am

12:00 pm

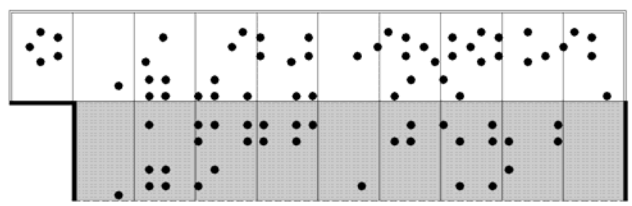
12:10 pm

Figure 16-b: 2-Dimensional Mapping of Cafeteria Occupancy (May 27, 2004).

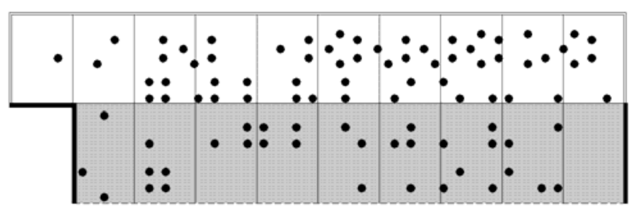
12:20 pm



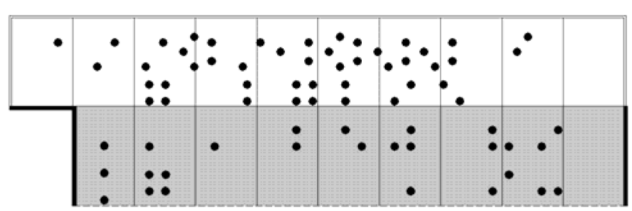
12:30 pm



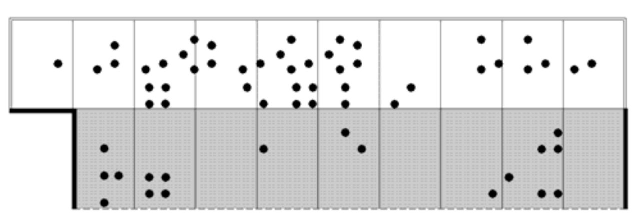
12:40 pm



12:50 pm



1:00 pm



Occupancy Rate Analysis

To more closely quantify this relationship between seating preference and views, data from all days of observation in the cafeteria were aggregated. Specifically, data for each 10 minute interval was averaged over all 6 days of observation. A mean percentage of occupancy for "view" and no-view" zones was obtained for each interval and plotted as a function of time (See Figure 17).

The data show that percentage occupancy in "view" areas was consistently higher than that in "no-view" areas. During early time intervals when overall occupancy is low and the cafeteria is just opening (i.e. 11:30am to 12pm), occupancy rate was up to 15 times higher in areas near windows and views compared to areas towards the interior. During later time intervals when overall occupancy is high and the cafeteria is almost full to capacity (i.e. 12:30pm to 1:00pm), occupancy rate was less drastically different between "view" and "no-view" zones. Though more people still chose to sit near views and windows during these times, "view" occupancy was instead 1.5-2 times higher than "no-view" occupancy.

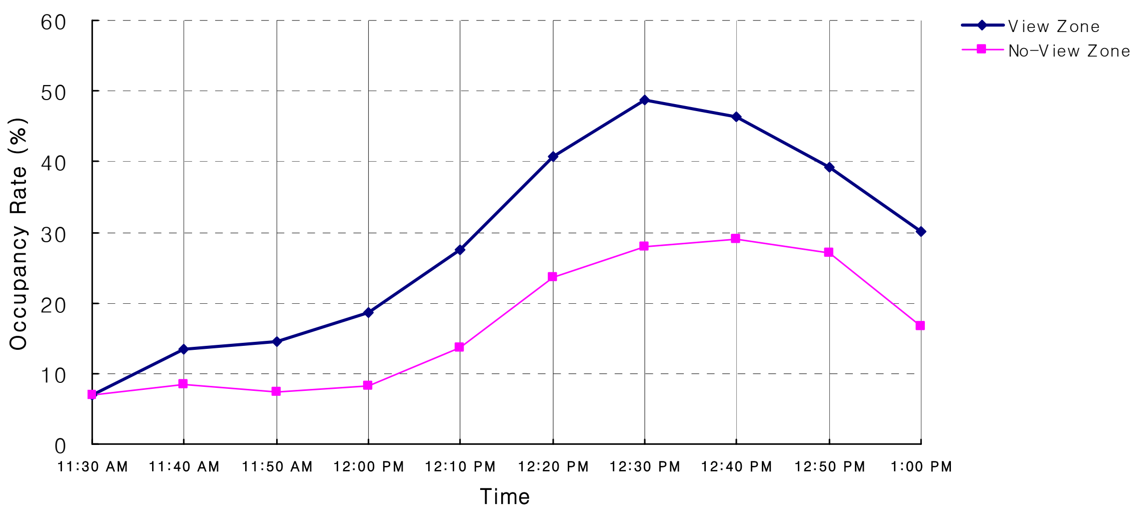
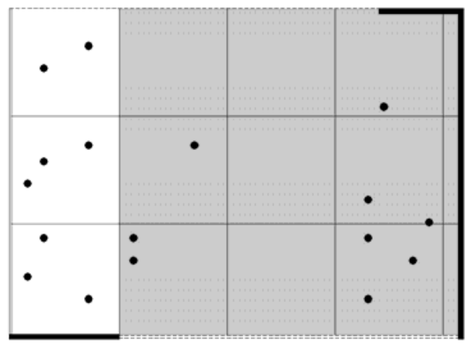


Figure 17: Comparison of Mean Occupancy Rates between "View" and "No-View" Areas (University of Michigan North Campus Cafeteria).

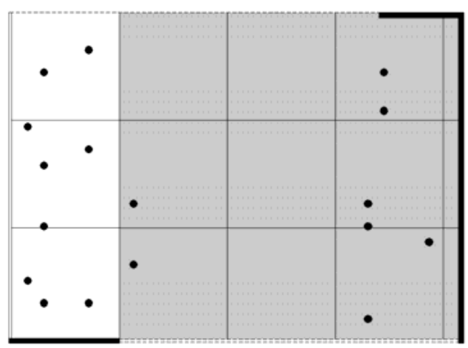
3.4.2 University of Michigan Taubman Medical Library

Below is an example of two-dimensional seat selection mappings over a period of six 30-minute time intervals in the afternoon of October 6, 2004 at the University of Michigan Taubman Medical Library (See Figure 18). Perusal of the occupancy progression on October 6 show a general trend of higher density in "view" areas (near the left white-shaded side of the graphs) compared to "no view" areas (right side of the graphs). This difference in occupant density between "view" and "no view" areas, however, seems less drastic than that of the cafeteria data. Similar observations are found in the two-dimensional mappings from a morning observation period (9:00am-12:00pm) on November 3, 2004 (See Figure 18). Again, density is slightly higher in "view" compared to "no view" areas. Exceptions are in the early morning (9:00 – 10:00am), during times of lowest total occupancy, when occupant density is higher in "no view" areas than in "view" area. Data from these two days of observation are generally representative of trends seen on other days at the library (please see Appendix C2 for seat selection mappings from other days of observation).

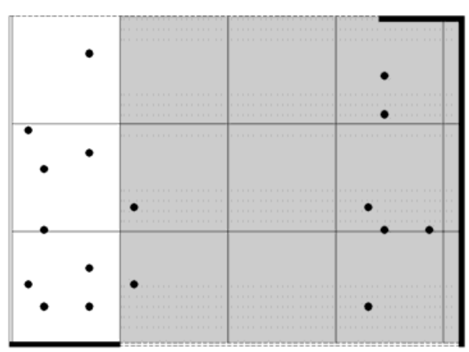
Figure 18-a: 2-Dimensional Mapping of Cafeteria Occupancy (October 6, 2004)



2:30 pm

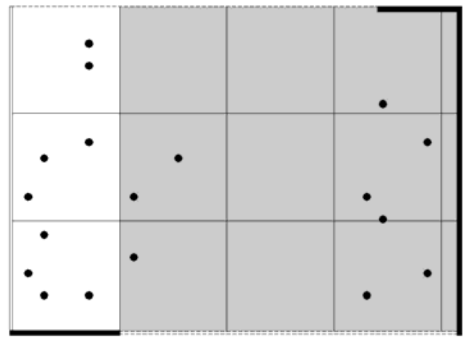


3:00 pm

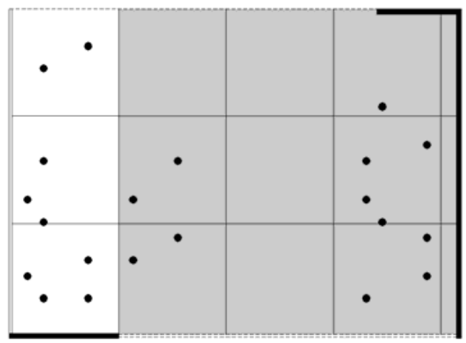


3:30 pm

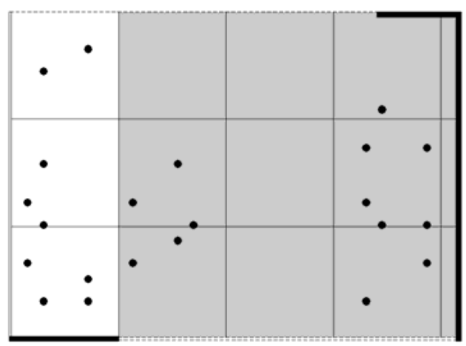
Figure 18-b: 2-Dimensional Mapping of Library Occupancy (October 6, 2004)



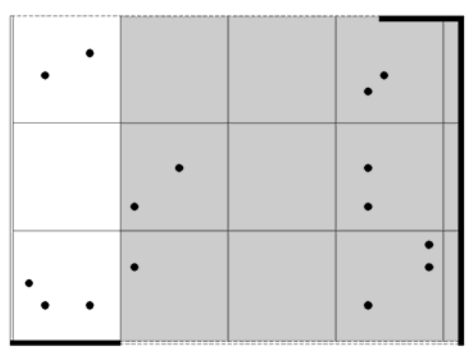
4:00 pm



4:30 pm

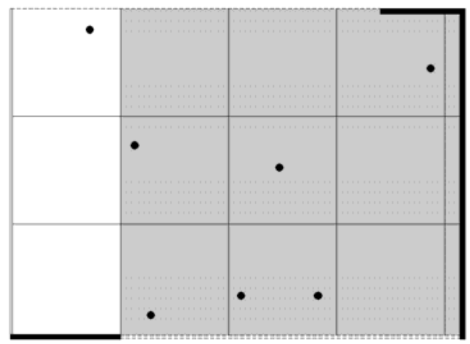


5:00 pm

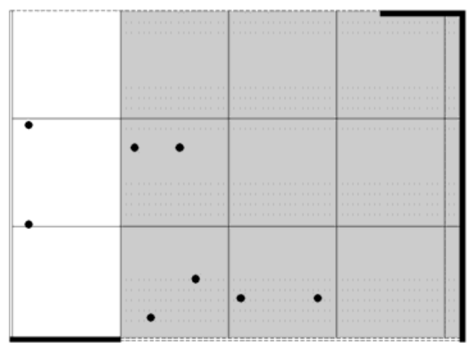


5:30 pm

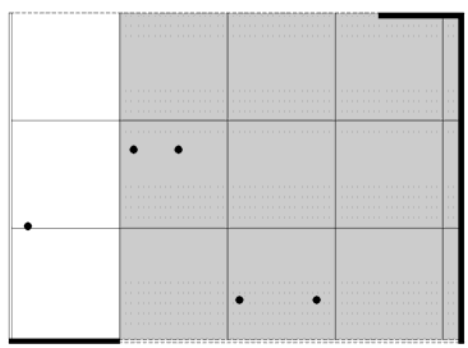
Figure 19-a: 2-Dimensional Mapping of Library Occupancy (November 3, 2004)



9:00 am

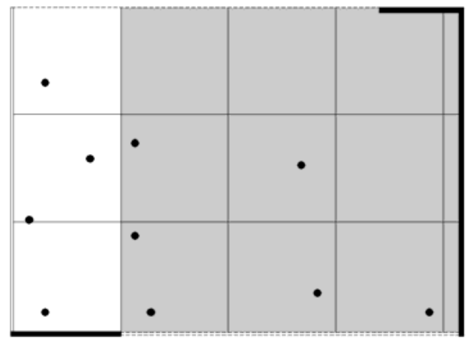


9:30 am

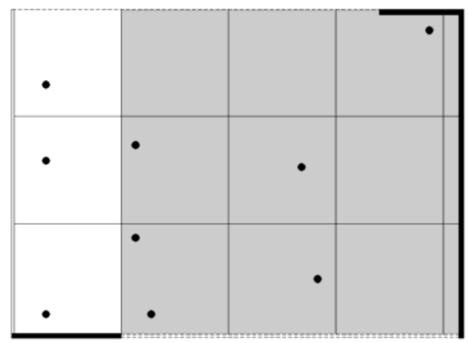


10:00 am

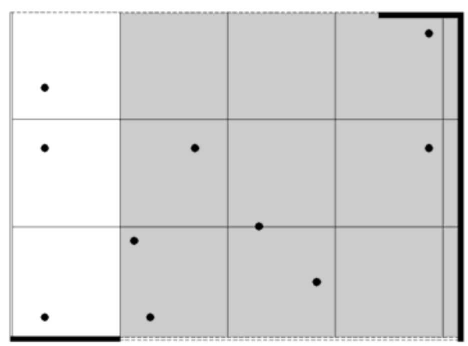
Figure 19-b: 2-Dimensional Mapping of Library Occupancy (November 3, 2004)



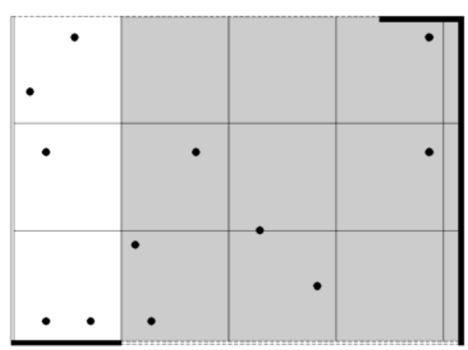
10:30 am



11:00 am



11:30 am



12:00 pm

Occupancy Rate Analysis

Similar to the cafeteria data analyses, data from all days of observation in the library were aggregated, to more closely quantify this relationship between seating preference and views. Data was averaged for “view” and “no-view” zones for each 30-minute time interval over all 5 days of observation from 9:00am to 12:00pm, and 2 days of observation from 2:30pm to 5:30pm. A mean percentage of occupancy for “view” and no-view” zones was obtained for each interval and plotted as a function of time (see Figures 19 and 20).

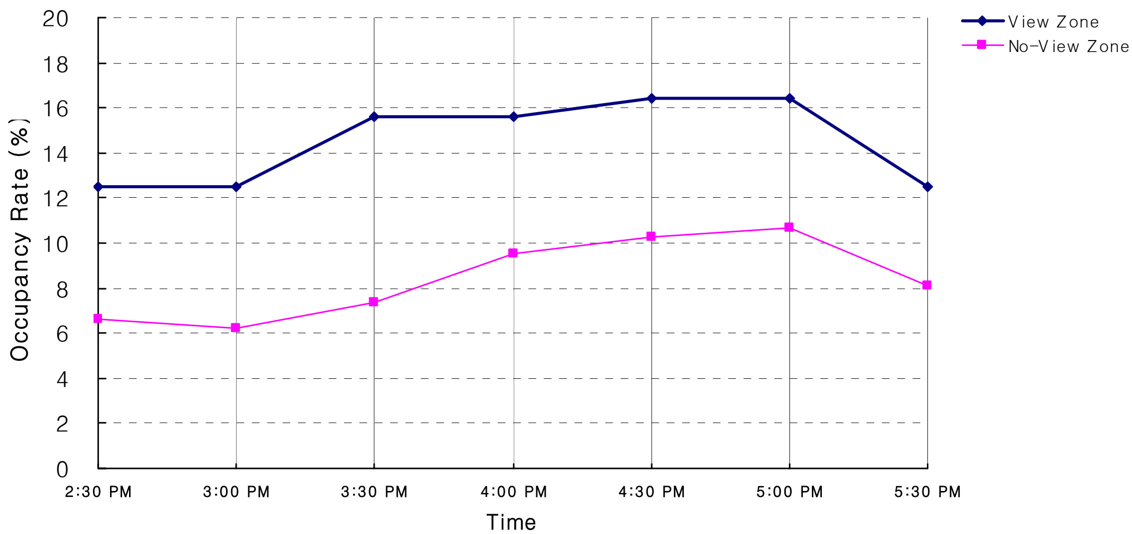


Figure 19: Comparison of Mean Occupancy Rates between “View” and “No-View” Areas from 2:30pm to 5:30pm (University of Michigan Taubman Medical Library)

In general, percentage occupancy in the “view” zone was higher compared to that of “no-view” zones. Again, people chose to sit near the windows and views. Interestingly, the difference between “view” and “no-view” occupancy rates was much smaller, and less drastic than that of the cafeteria. In the cafeteria, differences in occupancy percentage between “view” and “no-view” areas ranged from 11 to 22 percentage points, whereas differences in the library ranged only from 0 to 9 percentage points.

This discrepancy suggests that views may hold higher value in spaces used for social purposes compared to work purposes. Data from the library precluded any firm conclusions about which type of seating was chosen first or filled up more quickly, as overall occupancy rate did not fluctuate from low to high.

One exception to the general trend of higher “view” than “no-view” occupancy was during early morning time intervals from 9:00-10:00am (see Figure 20). During this time period, the occupancy rates were instead even or reversed, with more people choosing to sit in “no-view” compared to “view” areas. It is possible that only the most studious students study at the library during these early morning time periods. Thus, consistent with findings that view is less important in spaces used for work purposes, it can be explained that, early in the morning, persons with work in mind show up in the library, and do not pay attention to the availability of views in the space. In fact, these occupants may actually prefer “no-view” areas for purposes of increased concentration and minimal distraction.

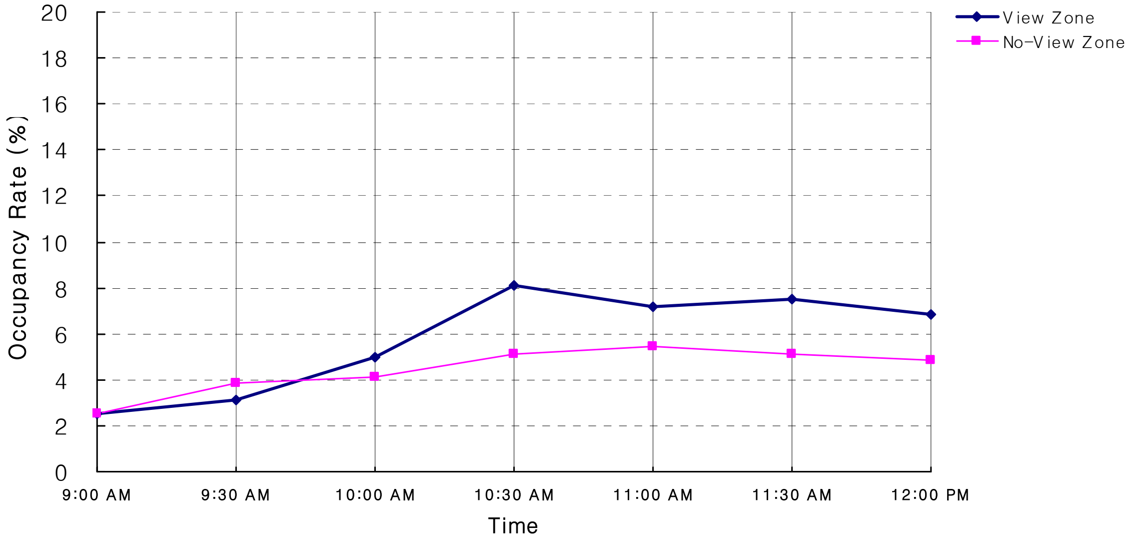


Figure 20: Comparison of Mean Occupancy Rates between “View” and “No-View” Areas from 9:00am to 12:00pm (University of Michigan Taubman Medical Library)

Together, data from both the cafeteria and the library quantitatively support hypotheses that people prefer and place value on window view seats. In both test spaces, occupancy rates were higher near windows and views. Additionally, in the cafeteria where there is high fluctuation of the number of occupants during the lunch time, data showed that seats near window views were chosen first and filled up more quickly.

3.5 Discussion

Analysis of our seating occupancy data in both a social space and a work space showed that people are more likely to choose seats near a window and an outdoor view compared to an interior seat with no view. Indeed, two-dimensional mapping techniques showed visually that occupancy density was higher in areas with a view, especially during times when less people are present and more seats are available to choose from. Only as more people arrive and less window view seats are available do the interior spaces fill up. These trends were confirmed through a graphical analysis averaging across observation days for both sites. Specifically, the occupancy rates of “view” areas were consistently higher than that of “non-view” areas. Additionally, seats near windows and views were chosen first and filled up more quickly.

Further comparison of data from the cafeteria and the library showed that the difference in preference for seats near windows and views was more pronounced in the cafeteria social setting than in the library work setting. Possibly, windows and views may be more highly valued by people spending time alone or in social groups during leisure hours than those during work hours who wish to concentrate without distraction.

The present findings regarding the effects of view on psychological preference and assigned value were not accounted for by any differences in environmental conditions such as temperature or humidity. Data measuring light levels, however, showed greater variability and high overall light levels near windows compared to interior areas. These data provide clues that greater availability of light may account for people's increased preference to sit near a window and a view.

Clearly, the present data confirm that people assign value to and prefer sitting near windows and outdoor views. Several factors may account for such a preference. For example, it is well documented that exposure to light can improve mood; in fact, Seasonal Affective Disorder is a mood disorder where depressive mood is associated with lower availability of light during the winter months. Perhaps the psychological benefits of sitting next to windows and views where there is more light accounts for peoples' assignment of value to views. Another possibility lies in the benefits of exposure and proximity to views of nature. Many find exposure to nature restorative for energy and mood, and thus may prefer to sit near windows and views.

4 Conclusions

Goals of this project were to quantify what lay notions and past experiential and qualitative research have suggested: that views and windows have value. In the first part of the project, we conducted an analysis of the 2002 BOMA Experience Exchange Report to find that availability of view, or height of a building, is positively related with assigned property value. We also polled and interviewed hotels, residential buildings, and office buildings to find that a significant number of buildings considered view when pricing their units. Together, these studies showed quantitatively that views and windows have economic value.

In the second part of the project, we recorded the seating selection occupancy rates of two test spaces, the University of Michigan North Campus Cafeteria and the University of Michigan Taubman Medical Library. Our findings showed that people prefer and are more likely to choose to sit near windows and views. Occupancy rates for areas near a view were higher than areas distant from a view, and these windowed view areas also filled up more quickly. Together, these results showed quantitatively that people assign psychological value and preference to views and windows.

Overall, this project provides a foundational analysis showing empirically that views and windows have psychological and economic value. We also performed further analyses of other variables that may affect this basic relationship between views/windows and value. For example, by examining the type or function of the buildings in our analyses, we found that the view/window relationship to cost may vary according to the business conducted in the building. Also, by examining different types of test spaces (i.e. social versus work), we found that the view/window relationship to psychological preference and value may vary according to the type of activity performed in a space. Clearly, these preliminary findings indicate a need to further explore the intricacies of the value of windows and views, to better understand when they are valuable and when they are not. Such an understanding of factors that influence the value of a window/view will better inform our consideration of when views should be prioritized in architectural design or real estate cost.

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