Env481

December 13th 2016

Building Comfort and Wellbeing in the Context of The University of Toronto

Abstract

According to the Environmental Protection Agency, the average person spends 90% of their life inside buildings (Rowell, 2015). It follows that the indoor environment plays a major role in the health, wellbeing, work productivity, and quality of social interactions for the inhabitants of a building (Gray, 2015). This study, conducted at the University of Toronto aims to examine the issues and relationships between people and the buildings they inhabit. The question we explore is: "What are the main issues that pose challenges to the comfort and wellbeing of the inhabitants in building(s), if any, and how do we arrive at solutions to maximize comfort and wellbeing within these buildings?"

For the purpose of this study, *building comfort* and *wellbeing* have been defined as a building's ability to provide spaces which enhance productivity, facilitate social gathering and engagement, and are generally perceived as comfortable for inhabitants. Furthermore, the word *inhabitants* is used to identify users of a building rather than the word *occupant*. This definition works off of Cole, et al.'s (2008) notion of acknowledging the "inhabitant's" sense of place within and engagement with a building, being active in its functioning rather than an "occupant", who is merely a passive recipient of fixed conditions.

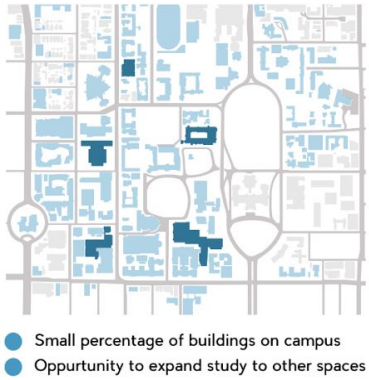
Throughout the course of this research, the issues and relationships of wellbeing, light, temperature, and air quality were studied in five buildings on the University of Toronto campus. Within these five buildings, we gathered data from three different parts of the building which consisted of multi-use spaces as well as spaces used for a single purpose. The three space categories chosen within the five buildings were social/communal spaces, individual work spaces, and lastly learning/presentation spaces such as lecture halls.

The research aimed to create an initial database that will aid our client, the Sustainability Office at the University of Toronto, in assessing inhabitant's self-evaluations of their comfort in particular campus spaces. To do this, we distributed a 19-question survey in our chosen spaces, engaged in conversation with our respondents, and made structured personal observations about the spaces. The inhabitants' perceived ability to engage in the activities they came to the space to do were studied through the analysis of data gathered. Recommendations were then made in order to reconcile any issues discovered which may hinder inhabitant wellbeing and comfort. In addition, the possibility of a continuous feedback method is explored, which may allow the Sustainability Office to continue collecting data on a regular basis.

Methodology

In conducting this research, five buildings on the University of Toronto campus were chosen as areas of study. These include Hart House, The Bahen Centre, The Medical Science building, Sidney Smith and Rotman Commerce. These buildings were selected based on their multi-purpose design and accessibility by variety of inhabitants such as students, faculty and staff.

METHODS: CHOSEN STUDY AREA



Primary data was collected through two different methods of field research. Firstly, an informal direct observation of the space was conducted in order to assess existing conditions of said space. These observations noted the amount of windows, size of the windows, how people were using the space, etc. Further data was collected through a structured questionnaire administered to individuals using the space in question. This method was chosen as it allows for useful insight into user experiences. In conducting data analysis, the potential downfalls of surveys were also considered as perceptions of comfort and wellbeing can be heavily influenced by biases and are subjective. In consultation with the client, a hundred and fifty surveys were considered substantial enough to gather initial data but not confirmatory evidence about our research question. These surveys were equally divided through the chosen buildings and carried out in two rounds. In order to allow for cross building analysis, spaces in these buildings were classified according to functions that encompass social/communal spaces, individual workspaces, and learning/presentation spaces. Ten surveys were conducted in each of these spaces.

It was deemed important to gather data from a variety of inhabitants such as students, faculty, staff and others, so as to represent a full range of experiences within the chosen buildings on campus. In designing the survey, some introductory questions about how the inhabitant uses the building were asked. This was done to identify patterns, such as how many hours per week people spend in the building. The other questions include both a quantitative (1-5 rating system) aspect as well as a qualitative option (comments) in order to get well-rounded responses. Our surveys were structured queries with the occasional open-ended conversation. Prompts were also given in order to rate certain aspects of the space (lighting, temperature, etc.) on a scale of 1-5, as well as sections for individual responses and general comments.

Our survey produced mixed quantitative data and qualitative data. The qualitative component of the questionnaire helped establish relationships between given variables and outcomes (Choy, 2014), whereas the qualitative component helped create a wider picture of people's perception of wellbeing and comfort. Potential respondents were engaged by presenting an information board that included an excerpt about our study and a conversation starter. In surveying members of the general public, challenges were foreseen with capturing our audience's attention long enough to answer the two-page survey. In order to deal with this issue, incentives were provided in the form of edibles and a chance to draw for a gift card.

Secondary data was collected through a review of existing literature and post-occupancy evaluations. This was done to create a triangulation of methods achieve a convergence of data that can strengthen the outcomes of our study. At the analysis stage we coded all our responses in order to simplify our data. Through a system of open coding the unstructured material was categorized and placed (Bryman, 2008).

Background/Literature Review

It is well supported that the design of a building should first and foremost be oriented around the people within the space in order to provide comfortable surrounds for most of the inhabitants. With poor design, inhabitants can be affected in ways they may or may not be aware of. “Irrespective of its function, the impact of building on its users can be twofold—positive or negative” (Muhammad, Sapri, & Sipan, 2013). Sick Building Syndrome (SBS) is one term for a negative effect, and occurs when there is increased absenteeism due to illness. This can be attributed to the indoor environmental quality (Brager, 2013; Victor, Chang & Yang, 2016). In addition, well-designed buildings, in terms of occupant comfort and wellbeing, include a certain degree of occupant control over some aspects of the space such as windows and blinds (Brager, 2013).

In her thesis paper, Coleman (2016) rigorously assessed the “human factor” involved in buildings by focusing on inhabitant wellbeing, productivity and health (Coleman, 2016). She studied the net positive Centre for Interactive Research on Sustainability (CIRS) building on the University of British Columbia campus and concluded that inhabitant productivity is enhanced due to “common contemporary workplace design”. Applying this knowledge to the University of Toronto campus, it may be said that improving the overall perception of a building's sustainability via knowledge and information may in fact improve people's attitudes towards their built environment. Coleman (2016) used an investigative post occupancy evaluation for her study and a similar approach was adopted for this research by conducting public surveys. The goal of a POE is to “provide feedback to stakeholders as to how well the building is functioning,

both for its designed intent and for users" (coleman, 2016). Similarly, this study aims to provide the same information to our client the Sustainability Office.

It must be noted that the scope of this study narrowed the indicators of comfort and wellbeing to only a few aspects of the building such as temperature, air quality and lighting. These aspects, however, only constitute a small part of the broader definition of comfort and wellbeing. In a study conducted by Muhammad, Sapri and Sipan (2013) on academic buildings and their influence on student wellbeing, it was found that there are six significant categories that constitute students' comfort in buildings. These categories are: 1. comfort, 2. health and safety, 3. access and quality of the facilities, 4. space provision and adequacy, 5. participation and inclusiveness, and 6. interaction. Our research briefly makes recommendations about two of these categories, i.e. "space provision and adequacy" and "participation and inclusiveness". The additional categories represent further options for continued research.

Additional precedent studies have been used to inform this research's exploration of relationships between inhabitant comfort and energy consumption. In Lawrence and Keime's (2016) paper *Bridging the gap between energy and comfort: Post- occupancy Evaluation of two higher- education buildings in Sheffield*, the relationship between energy consumption and inhabitant comfort in two UK education buildings is investigated. It was found that the building using passive energy strategies prompted an increase in inhabitant control of their environment. This led to an increase in inhabitant comfort, and also allowed for less energy consumption than other examined buildings. In another paper, *Benefits of improving occupant comfort and wellbeing in buildings*, Brager (2013) recommends, that manual control of the indoor

environment will increase the IEQ (Indoor Environmental Quality), and in turn improve the inhabitant's comfort and wellbeing.

The methods section of this paper was informed by Victor and Chang's (2016) *Comparing Mixing and Displacement Ventilation in Tutorial Rooms: Students' Thermal Comfort, Sick Building Syndromes and Short- Term Performance*. The researchers use two methods of research the first method being an open-ended interview, where each researcher creates a conversation with the inhabitants. The second method was closed-ended, and consisted of a survey that was distributed around the buildings. A similar mixed approach was taken for this paper.

In addition, precedent studies such as *A multidimensional post-occupancy evaluation tool. Building Research & Information* (Candido, Kim, Dear, & Thomas, 2016) help assess the shortcomings of our methods in comparison to other post occupancy evaluations. Over the past years, post-occupancy evaluation (POE) tools have shifted, adapted and improved, but the "core mission has remained the same: to close the loop between design and performance for building owners, designers and operators based on quantitative feedback from building occupants" (Candido, Kim, Dear, & Thomas, 2016). This article expresses the concern that user feedback on its own may not be enough to assess how well a building is doing. Despite there being an inherent issue with subjectivity and perception, our client finds that the feedback may be helpful in informing further research.

Main Findings

While our sample size was small - 5 people per space, and 15 people per building - there were some outstanding patterns. Firstly, many people rated aspects of comfort and wellbeing neutrally or otherwise indicated to the researcher that they did not care about or notice the aspect in question. In some cases this could be indicative of the aspect performing sufficiently, but in other cases it may be indicative of issues in need of further inquiry. One issue may be what we may refer to as the "resignation" factor, a result of low expectations of the institution represented by the building. This was echoed in negative responses across all study spaces: a common complaint being that the space or building had an impersonal, clinical, or institutional feeling. Other respondents, especially in the Bahen Centre, commented that they did not like the building because of pre-existing factors such as the fact that they were there for a lecture or because they were already stressed. Another side to the "resignation" factor may be that occupants do not expect their architectural surroundings to influence their mood or wellbeing, and are *resigned* to being a passive recipient of the spaces they are in. This may be influenced by limitations on students' choices of buildings they go to for class, as these are assigned, as well as their daily schedules, which may not have much time between classes and restrict their choice of study and social spaces. This factor was illuminated by the high rate of neutral responses - without exception, every question had a higher rate of middle/neutral responses than any other response type.

Secondly, the activity being undertaken in the space and the degree of freedom of choice in being there, seemed to influence perceptions of wellbeing and overall satisfaction. Social gathering spaces were rated higher than other kinds, most likely for this reason. As noted above,

several users of the Bahen Centre gave the building low wellbeing ratings since most of them were there for lecture (and were therefore stressed), and would not have been there if they did not have to. This correlated somewhat with low ratings of other aspects of the space, though a larger sample size would be needed to determine causality.

Third, all of the buildings were generally rated as too cold, and that the temperature had a negative impact on inhabitants' productivity. The same was not true for spaces that tended to be rated as too warm, though less of a correlation could be found with productivity in this aspect. Based on our experience as students, we believe this may be due to the tendency of students to "camp out" in a space, staying in one place for several hours at a time to complete assignments, eat, socialize, and read. This minimal movement results in lower resting heart rates and therefore blood flow, causing students to feel cold more easily. The possible prevalence of drafts was not included in our study, but it would be helpful for future studies to include it in order to rule them out, additionally because drafts are a known factor in buildings afflicted with SBS (Sick Building Syndrome).

Fourth, some patterns were found in higher occurrences in some buildings than in others. Both Rotman Commerce and Sid Smith were said to be too cold and too loud (for students trying to study and eat in the cafe, which many were). Both buildings also stood out because they best exemplified the overall pattern that spaces with multi-purpose designs tended to be rated higher than ones with specific functions, since users tended to do several things in one space, and single-function rooms tended to inhibit their abilities to do so. For example, the Sid Smith cafe is designed to facilitate eating and socializing, but several respondents noted that there were not enough outlets, since they also study there. These buildings were also the ones that several

respondents said felt cold and institutional. This is potentially due to the contemporary design of much of the Rotman Commerce building, which some users find to be forbidding (in contrast, users of Hart House gave it high ratings because of the welcoming atmosphere of the staff, other inhabitants, and the warm and comfortable study area).

Finally, across all buildings, 50.3% of respondents said the space they were in provided a sense of wellbeing, and 18.5% rated it as neutral (that it neither enhanced nor took away from their wellbeing). 47.1% said their space enhanced their productivity, with 25% answering neutrally. The high wellbeing and productivity ratings occurred despite the occasional strongly negative ratings of aspects of the space, such as the temperature being too cold or there not being enough natural light. The forgiveness factor may be at play, but also influential is the fact that many different types of spaces were included in our study, which affects how important productivity is to the people using the space. For example, a cafe is generally used primarily for eating, socializing and group work, or by people who can work in loud places, so productivity is less of a concern than in, say, a library. For further studies, a bigger sample size is needed if more accurate quantifiable findings are desired.

Limitations of Study

Several factors contributed to the limitations of our survey; not only was our sample size small, but our original approach assumed that respondents would give answers related to the building itself - the architecture, the facility, and so on. However, we received answers about the furniture, the amount of people relative to the amount of room for them, and so-called “vibes.” This may be indicative of a shortcoming of this study. The surveys were approached from a

design/architecture mentality rather than a subjective, personable approach. Most of our respondents were undergraduate students, and we did not include a question of how long any person had been at the university. Perhaps a relationship could have been discovered between how well acquainted a respondent is with a building and their likelihood of a neutral response. Through the recommendations section, ideas about improved survey design and a proposed continuous-feedback method have been put forth. However, this study is still valuable as a pilot project for further research, and to capture the most outstanding patterns among the target buildings.

Further research and Recommendations

Our recommendations have emerged from a combination of observed areas of deficiencies within the studied buildings and findings from scholarly literature relating to building comfort and wellbeing. Since the sample size of our research was quite small and the primary data does not lead to specific conclusions, we found it important to ground recommendations in existing literature to ensure that the application of recommendations featured effective results. An assessment of recommendations via benchmarking against existing literature and accepted standards seemed to ensure the greatest likelihood of effective results.

Overall, our recommendations stem from the notion of acknowledging building users as inhabitants. In the context of this study, this emerges when buildings facilitate engagement between building and user, and enables a sense of belonging and empowerment within themselves. Through the literature and our own analysis, we found that allowing users to play an active role in the maintenance and performance of the building was critical to the concept of

well-being and comfort. A primary way to ensure that users are treated as inhabitants is to facilitate an engagement of the inhabitants with the building in question. This can be done through the practice of two-way interactions between building and inhabitant (Brown, 2009). Based on our observations and the existing literature, our recommendations include the introduction of continuous feedback systems, increased physiological control of inhabitant comfort, and direction for future research. These recommendations are discussed in more detail in the following paragraphs.

Throughout the scholarly literature, there was an emphasis on dialogue and communication between inhabitants and the building. This can contribute to the empowerment of inhabitants, and inform research of existing building deficiencies (Coleman, 2016). It can also increase the forgiveness factor and aid in achieving optimal building performance by drawing on inhabitant knowledge and agency (Coleman, 2016). These findings can be translated in our own recommendations through the application of a continuous feedback strategy. One way to implement a feedback strategy is through the inclusion of a short occupancy evaluation in the course evaluations surveys, which are administered at the end of every semester. This tactic could be an easy and beneficial way to receive campus-wide data on inhabitant perceptions of classroom and building satisfaction, as well as potential building deficiencies. Furthermore, Leaman & Bordass (1999) suggest that if inhabitants are aware that efforts are being made to overcome issues, the forgiveness factor is likely to increase. This means that if the inhabitants of the University of Toronto's buildings are aware that efforts are being made to engage and understand building deficiencies, forgiveness for unsatisfactory conditions may also be increased.

Both Cole (2008) and Reckermann (2014) suggest that increased inhabitant control over physiological conditions is crucial to the empowerment and wellbeing of an individual. This can be implemented through the installation and use of blinds to control daylight. Our study found that inhabitants reported an excess of daylight in the spaces, which often negatively impacted their productivity. Similarly, during our own meetings in the East side common room of Sidney Smith, we found that the afternoon sunlight was strong, and produced a glare. This made it difficult to work on laptops or converse with group members. We did notice that there was a presence of blinds in the Sidney Smith common room; however, the button that enables us to control the blinds was out of sight and hard to distinguish. These findings point to a number of potential and relatively simple recommendations that are briefly discussed below:

1. An increase in the installation of blinds in buildings is recommended, particularly those with large windows that are exposed to the sun. For example, the library in the Rotman Commerce building is often too bright and inhabitants stated that it can be hard to get work done in the space. Unlike Sidney Smith, the library does not have operable blinds, and so the inhabitants are forced to move to a different space if the natural light is too bright.
2. An installation of blinds that can be controlled by inhabitants is also recommended. This will allow the inhabitants to customize their space to suit their needs, thus enabling them to engage and interact with their space.
3. Ensuring that there is a high level of accessibility and information available for the inhabitants, so that they are well aware of their ability to control their environment. As seen in the Sidney Smith common room, the benefit of having the option of controlling a

space is diminished if inhabitants are not educated or aware that this option exists. Coleman's (2016) study suggested that when operable windows or blinds were not used, it was often based on a lack of knowledge about control options. It is just a matter of informing inhabitants on the availability of control options. In the case of Sidney Smith, this issue may be combated by an addition of signage in areas where manipulation is available.

For future research, it is recommended that the researchers conduct both open- ended and close- ended surveys. A conversational survey would provide the conductors relevant qualitative data, whereas a specific close- ended survey would provide more quantitative data. We found that respondents were able to convey their thoughts and feelings about the spaces more clearly through conversations and anecdotal information. More buildings on campus can also be examined in order to analyze the overall comfort and wellbeing of the overall university. Our research was limited to five buildings due the time constraint and small group that consisted of five members. Overall, a larger survey sample base is recommended for more accurate results. We were able to conduct one hundred and fifty surveys and found that some aspects of our research were not fully examined due to our small sample base.

Conclusion

Our results, while difficult to quantify, provided a solid direction for future studies and investigation into the comfort of inhabitants in the University of Toronto, St George campus. While ideas about comfort are subjective and unique to each person and even vary season-to-season, there are general patterns which can be taken into account and designed for.

Our study found that warmer spaces are preferred to colder ones, literally and metaphorically - spaces should also be designed to encourage socializing and feelings of invitation and friendliness. Direction for such designs could be taken from campus spaces which already provide the desired experiences. Ultimately, studies on comfort in campus buildings should combine objective knowledge and subjective responses to create spaces that people can truly inhabit, rather than simply occupy.

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Appendix: Graphs and Charts

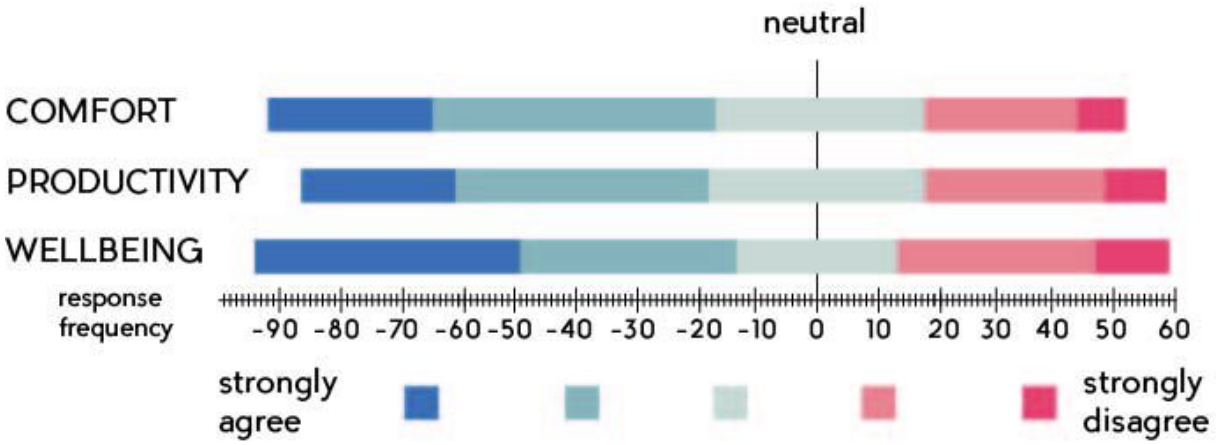

Fig 1: Responses to questions about Comfort, Productivity and Wellbeing

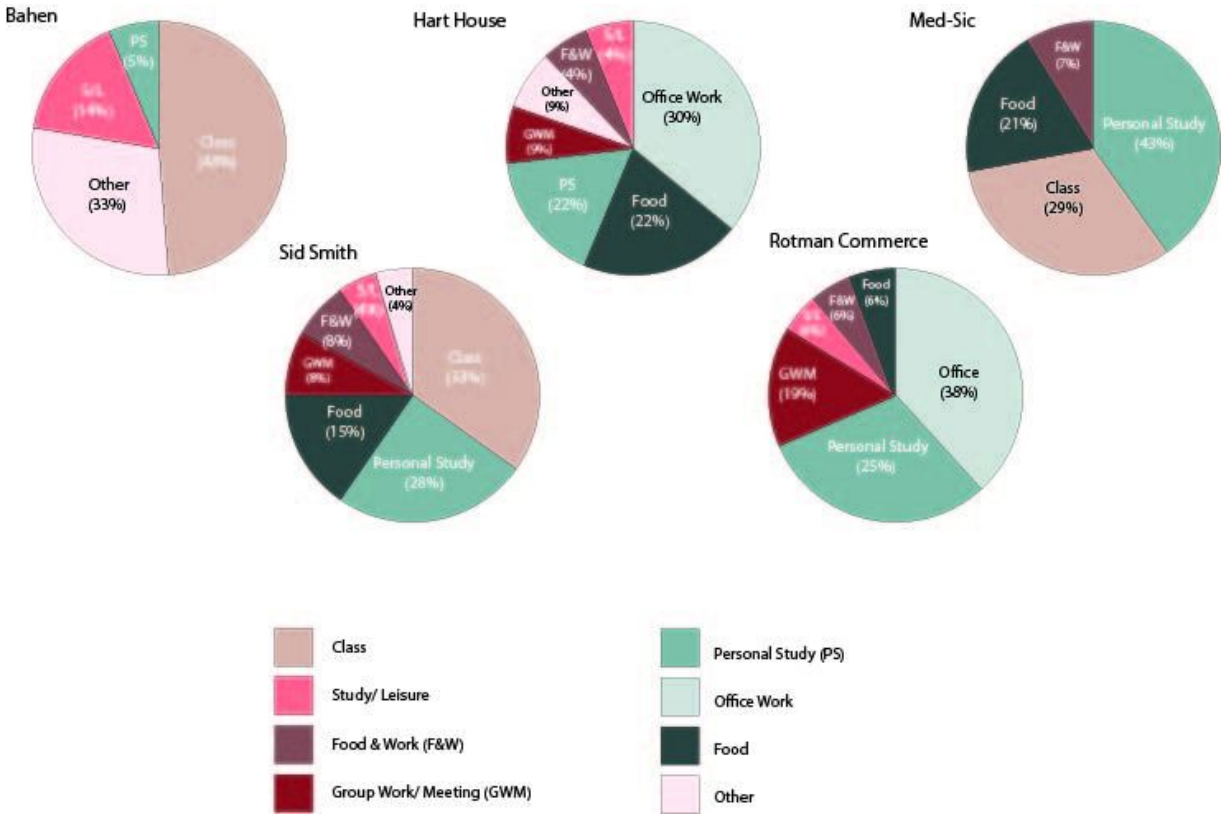

Fig 2: How each space was used among our respondents