Effectiveness of a Behaviour - Based Energy Conservation Campaign, Targeting Accessibility Door Systems on Dalhousie Studley Campus

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Environmental Problem Solving II

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EXECUTIVE SUMMARY

The purpose of this study was to determine the effectiveness of a community-based social marketing (CBSM) campaign in reducing the misuse of accessibility door systems by able-bodied persons on Dalhousie Studley Campus.

The research question was “Would a marketing campaign advertising the costs of using accessibility doors decrease the usage of these systems by able-bodied Dalhousie Studley campus members?”. The CBSM campaign consisted of a series of posters placed around campus, highlighting that the misuse of accessibility door systems on Dalhousie Studley Campus emit 14 tonnes of carbon dioxide a year (Delaf et al., 2017). Researchers executed a series of data collections before the campaign to act as a control, and then after to determine if there was a significant decrease in the mean number of patrons on Dalhousie’s Studley Campus misusing the systems.

There was no statistical difference in the mean misuse of accessibility door systems before and after the CBSM campaign (P=.98). Therefore, we fail to reject the null hypothesis that there is no difference in the means.

This research has placed emphasis that one small change can make a big impact. The results have suggested that Dalhousie should invest in new doors to reduce heat loss and encourage manual use. As well, another attempt at a CBSM campaign on Dalhousie’s Studley campus could be beneficial in continuing awareness of the negative impacts of small actions, such as misusing the accessibility door systems.

Acknowledgements are required for the authors of “*Accessibility Door Usage and Associated Cost on Studley Campus”* on their work in calculating the amount of CO_2 used by accessibility door systems on campus in a year. As well as Victoria Sandre and Dr. Amy Mui for their guidance and hardwork.

INTRODUCTION

There is an ever-increasing need for individuals, and more importantly societies, to minimize their energy consumption and maximize their energy efficiency to help offset the mounting environmental pressures that the globe currently faces. People must begin shifting their perceptions of energy towards an attitude more mindful of the costs and consequences associated with how it is produced and consumed.

The primary contributor to annual greenhouse gas emissions by sector in Nova Scotia is the generation of electricity (National Energy Board [NEB], 2019). A look into electricity generation by fuel type within Nova Scotia reveals that 58% is produced through the combustion of coal and coke; this particularly dirty method of production emits large quantities of greenhouse gases and air pollutants into the atmosphere (NEB, 2019)

Energy flow and consumption remains largely misunderstood by the average consumer; this, coupled with the fact that energy is seen as both a necessity and a commodity, has had a negative impact on how efficiently energy is managed (Aronoff, Champion, Lauer, & Pahwa, 2013). According to Aronoff et al. (2013), nearly two-thirds of the energy consumed within the United States is attributed to residential and commercial buildings. One way of addressing these issues is by looking at how to improve energy efficiency at large institutions such as university and college campuses, and how to promote and integrate energy conscious behaviour to reduce the environmental impacts associated with Nova Scotian energy production. By reducing the amount of energy wasted within institutions, energy consumption will be decreased resulting in environmental benefits and energy savings which can be reallocated back into budgets for further investment (Morris & Malley, 2018).

A previous study conducted on Dalhousie Studley Campus found that 14.251 tons of carbon dioxide (CO_2) are produced annually through heat loss and electricity usage by accessibility door systems (Delaff et al., 2017). The importance of accessibility systems cannot be stressed enough as they provide essential services to people that require them. It is interesting to note, however, that a percentage of the use of accessibility systems are by able-bodied campus goers. Many, if not most, pedestrians do not anticipate the consequences associated with using accessibility systems and take these services for granted. Various reasons can be speculated for the use of accessibility door systems by able-bodied persons including convenience, as well as a desire to use or gain satisfaction from using an automated system. Additionally, the physical setting or characteristics of certain areas induce increased use of accessibility systems.

For this study in particular, we saw a the greatest amount of people misusing the accessibility systems in the within the Killam Library located on Dalhousie's Studley Campus which separates the atrium from the North-West portion of the building (see Figure 1). Many people familiar with the building will agree that these large doors are particularly heavy. The original layout of the library when it was constructed in the 1960s included an outdoor courtyard which is now the atrium, thus the large doors are exterior doors meant to withstand the

elements (Campbell, 2019). Simon De Vet, a physics professor at Dalhousie University, measured that the amount of force required to open the Killam Library doors equates to 25 pounds; for reference, the exterior doors at the Halifax Shopping Centre require about 8 pounds of force to open (Campbell, 2019).

Community-based social marketing (CBSM), which aims to change the behavioural norms within a certain population, can be an effective tool for reducing energy consumption on university and college campuses, increasing institutional savings, and consequently reducing the environmental impacts associated with energy production (Desrochers & Mosher, 2017; Morris & Malley, 2018). Aronoff et al. states that “Community-based social marketing … is a theory that identifies and addresses barriers that impede individuals from converting attitudes and concern for the environment into action” (2013, para. 2). The design of our research project incorporates the use a CBSM tool termed “negative consequence” as a means of changing population behaviour. This tool operates under the assumption that a negative consequence, such as a penalty or discomfort, encourages individuals to act differently (Desrochers & Mosher, 2017). CBSM addresses the following barriers to sustainable actions: lack of motivation, lack of social pressure, lack of knowledge, forgetfulness, and structural barriers (Aronoff et al., 2013). By educating community members on sustainability topics such as energy conservation through the use of CBSM campaigns, institutions can help curb some of the environmental pressures facing us today and breed an environmentally friendly school of thought (Desrochers & Mosher, 2017).

CBSM tools have been proven effective on a campus setting, where the community is often tight-knit and highly impressionable. For example, The Fond du Lac Tribal and Community College (FDLTCC) in Cloquet, Minnesota saw successful results after using CBSM tools to implement a pilot recycling program. The College saw a 41% decrease in the amount of recyclables found in the garbage (*Tribal community-based social marketing recycling toolkit,* 2016). This success story inspired the CBSM aspect behind the project, hoping that if one campus were so easily influenced into sustainable, maybe Dalhousie’s Studley Campus could become more aware of the small actions that make all the difference.

The purpose of this research was to determine the efficacy of a CBSM campaign on reducing the use of accessibility door systems on Dalhousie Studley Campus by able-bodied campus goers. In doing so, this research hoped to educate the Studley Campus population on the impacts associated with a seemingly small and insignificant action that has widespread consequences. Furthermore, the objective of this study was to create awareness of the

connection between individual actions and sustainability, and to encourage people to make personal, environmentally conscious changes. Finally, the desired outcome of this research was to decrease the energy impacts associated with institutional electricity consumption through behaviour based energy conservation.

METHODS

A CBSM in the form of an infographic poster was determined to have the most potential to present the desired information clearly, as well as taking advantage of the extensive existing infrastructure of bulletin boards and poster areas on campus that are free for students to use. With the assistance of the university and a Green Grant, Appendix X, 40 posters were printed to be distributed on the campus around and between our study area. In order to assess the effectiveness of the CBSM, a count of assisted and non-assisted door use for the study locations was conducted before the campaign was started, and after poster placement. These counts were done for 30 minutes at mid-day when usage would be high, and times were replicated on different days of the week to have a consistent comparison. The before and after counts were also done at approximately the same times and days to have a consistent comparison between data sets. Based on a campus population of approximately 26,500 students, faculty and staff (Owen, 2019), a representative sample size of 379, with a confidence level of 95% and margin of error of 5% was calculated. Both sets of counts exceeded the required sample size with a total of 2795 people observed before poster placement, and 1192 after placement. Initial counts ran from February 4th to the 13th, posters were distributed on March 11th and 13th, and the second counts ran from March 13th to the 21st, with table Y showing the time and dates of before and after counts, as well as the locations of posters.

LOCATIONS

Four locations on the Studley Campus were chosen because of their high daily pedestrian traffic which could be measured without obstructing the use of the doors. They were the inside doors on the first-floor of the Killam Library separating the atrium and elevators, the first-floor north entrance to the Killam Library, the main east entrance of the Life Sciences Center, and the main north entrance of the Wallace McCain Learning Commons, as seen in *Figure 1*.

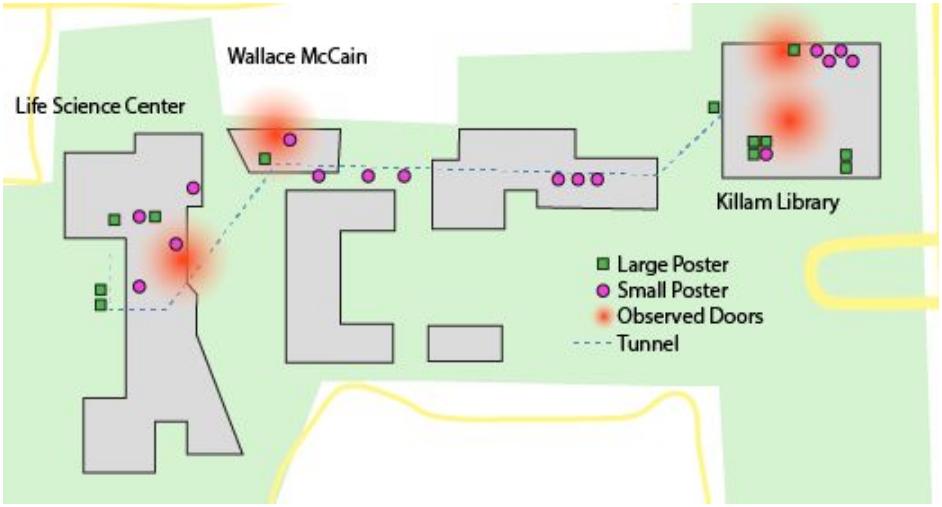

Figure 1 *Map of poster placement and observation areas*

Additionally, based on research by Deleff et al., the article by Campbell, and the experience of members of the group, the Killam Library was determined to have the hardest to open doors, and so a potentially higher rate of accessibility door use than the other locations. The comparison of entrance design and door type and accessibility issues found in our study could be used as reference for recommendations of future upgrades to older buildings.

COUNTS

The primary assessment tool of this project was a count sheet to determine the percentage of people using accessibility doors before and after the CBSM campaign. Table 1 shows the design of the count sheet with A) the name of the person doing the count, location of the count, and the date and time B) the number of people using non-assisted doors to enter or exit C) the number of people pressing the automatic door button who did not need to, and the number of people going through the open door following that press D) the number of people pressing the automatic door button who did need to, and the number of people going through the open door following that press E) additional observations on the location and patterns of use. With this design, all possible uses of the doors were classified, as well as the specific number of people using an open door after a button push. The section for additional observations proved to be important as new issues and relevant information relating to door design and the patterns of behaviour were found while performing counts, as seen on Count Sheet 1 in the appendix.

Table 1 *Sample Count Sheet*

A)	Name- Location-	Time-
B)	Non-Assisted Doors	
C)	Assisted Door Not Needed, Bracket Number Through	
D)	Assisted Door Needed, Bracket Number Through	
E)	Additional Observations	

POSTER

The second tool of the project was the poster that would potentially influence the behaviour of people using the doors. Because there is a valid use of accessibility doors by people with disabilities, the ethical design of the poster was important. The main message of the poster was to inform people of the environmental impact of the use of accessibility doors, and the second was that the target of this campaign was the unneeded use of the doors by able bodied people. The final poster design, *see Figure 2*, has a bright background to grab attention, with the main information in the middle of the poster, that accessibility doors cause (approximately) 14 tons of CO2/year (Deleff et al.). Below is the statement 'able bodied people can reduce their carbon footprint by not using accessibility doors unnecessarily'. This statement was written to instigate a behaviour change towards the use of accessibility doors, while also addressing that the focus is on the unnecessary use of these doors by able bodied people.

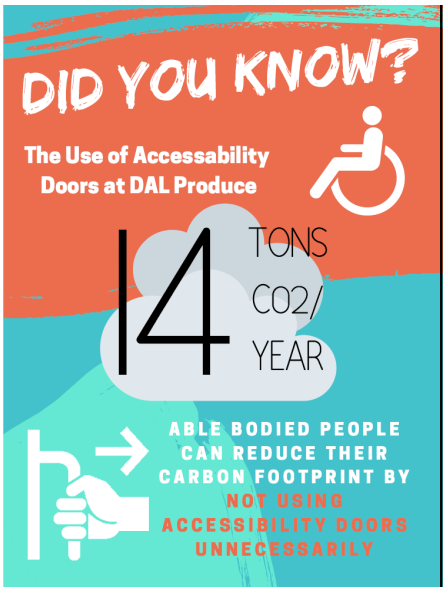

Figure 2 *Poster used by group to generate awareness of the carbon emissions associated with misusing the accessibility door button*

20 posters were printed on 11” x 17” sheets, and 20 posters on 8 ½” x 11” sheets, which were placed on the Studley campus as seen in Figure 1. Most posters were placed near the areas of study, with some placed along the highly trafficked tunnel between the Killam Library and the Life Science Center. Multiple posters were placed at the Killam main entrance, washrooms, and 3rd and 4th floor elevator bulletin boards. Posters were also clustered around the main entrances of the Life Science Center and the tunnel to the Wallace McCain Building. The Wallace McCain Building had fewer bulletin boards, so posters were placed along the tunnel connecting it to other buildings on campus. Some posters were not put up and kept on reserve in case any posters were damaged, removed, or covered up over the course of the study, however though some posters were removed near the final days of the study, their immediate replacement was not possible. Some posters were covered up slightly over time, as seen in Figures 3 and 4, but were moved to be more visible by group members before performing their counts.

LIMITATIONS

The main limitation of this study was the inability to classify the use of accessibility doors as needed or not needed. Because someone using an accessibility door could have an invisible disability, temporary mobility issues that are not observable, or in the case of heavy doors, a physical inability to open the doors, an accurate classification was not possible. Because the study was based on observation, only people with mobility devices, who were pushing a cart or dolly, or who had their hands full and could not easily use a door were counted as needing to use accessibility doors. This also created a potential bias based on if the observer determines a button push to be valid, or if they see that someone’s hands are full or not. This inaccuracy though was consistent across all counts and locations.

Additionally, when groups of people use an entrance at once, after leaving a class for example, a completely accurate count was not possible due to this high volume of use in a short period of time.. One observation at the Killam Library for example had 1022 people use the doors in a 30-minute period, making an accurate count difficult, as well as limiting the ability to determine if a button press was needed or not as described above. Therefore in our research there is an expected degree of error to account for those with non-visible disabilities and the researcher’s own human error, which can be seen in *Table 5* in the appendix.

Though the poster was designed to be bright an eye catching, many bulletin boards were full of other posters for various events, and constantly had new posters placed on them. Figures 3, 4 and 5 show initial poster placement, and the same bulletin board one week later. Because of time and budget limitations, a poster campaign was chosen for our study; for a long term behavioural change, a permanent, large scale campaign may prove more effective.

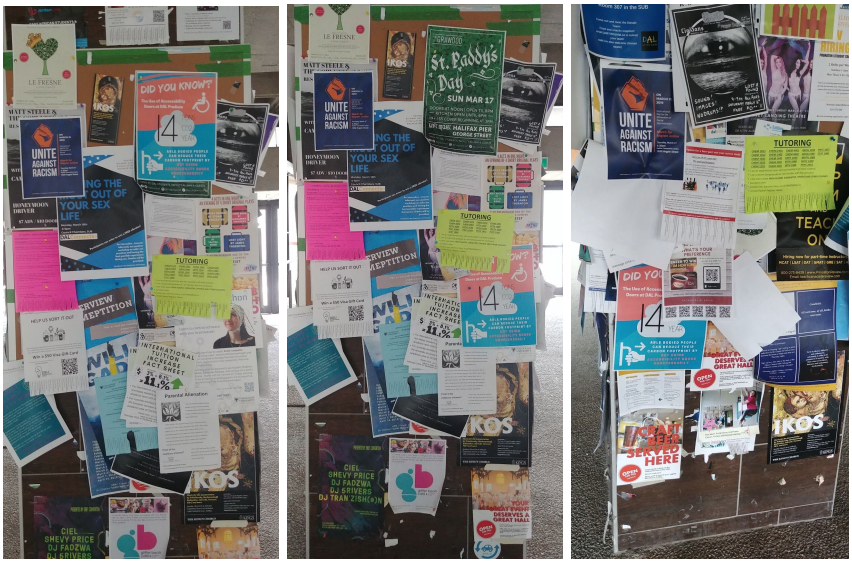

Figure 3,4 & 5 *Initial poster placement on the left, the same location one week later, and a different location one week after poster placement.*

RESULTS

As shown in *Figure 6*, a decrease in the mean amount of times the accessibility door systems were used by able-bodied participants was observed after the introduction of the negative consequence CBSM tool.

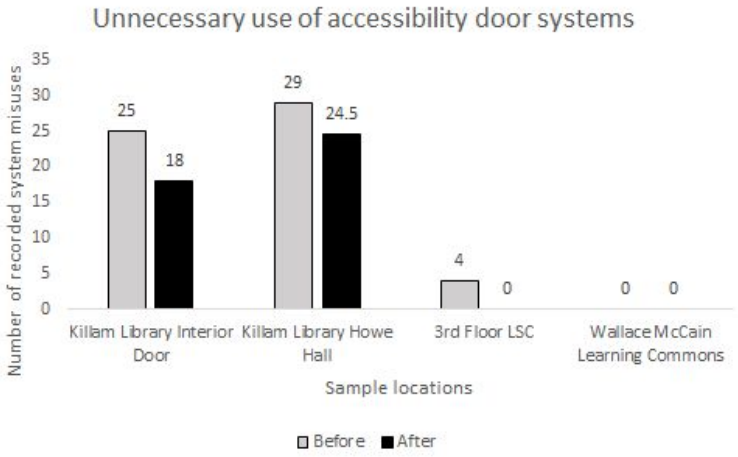

Figure 6 *A comparison of the mean amount of accessibility door system misuses at each sample location before and after the implementation of the energy conservation CBSM campaign.*

However, *Table 2* demonstrates that there is no statistical difference in the mean amount of times the accessibility door systems were unnecessarily used before and after the introduction of the CBSM campaign (*P*=.98). Therefore, there is a failure to reject the null hypothesis that there is no statistical difference in the mean amount of times the accessibility door systems were used by able-bodied research participants.

Table 2 *Two-sample t-Test assuming unequal variances for the unnecessary use of accessibility door systems before and after the implementation of the energy conservation CBSM campaign.*

	Before	*After*
Mean	7.25	7.083333
Variance	125.0714	95.84167
Observations	8	6
Hypothesized Mean Difference	0	-
df	12	-
t Stat	0.029645133	-
P(T<=t) one-tail	0.488418704	-
t Critical one-tail	1.782287556	-
P(T<=t) two-tail	0.976837409	-
t Critical two-tail	2.17881283	-

Figure 7 represents the total number of participants recorded during the duration of the research project. Fewer total persons were observed after the CBSM campaign was introduced compared to the total number of persons observed before the campaign.

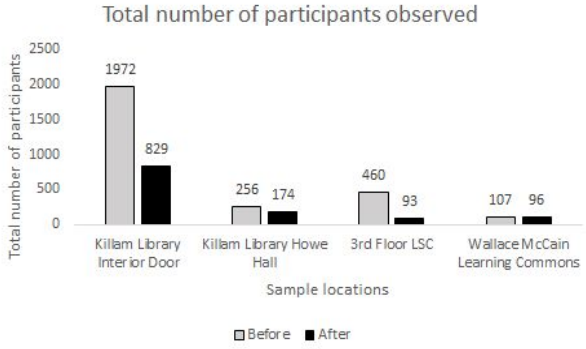

Figure 7 *A comparison of the total number of participants recorded at each sample location before and after the implementation of the energy conservation CBSM campaign.*

It is important to note that the results of a two-sample T-test conclude that there is no statistical difference in the mean number of participants observed before and after the CBSM campaign (*P*=.32); shown in *Table 3*.

Table 3 *Two-sample t-Test assuming unequal variances for the number of research participants before and after the implementation of the energy conservation CBSM campaign.*

	Before	*After*
Mean	349.375	198.6666667
Variance	121572.8393	37050.26667
Observations	8	6
Hypothesized Mean Difference	0	-
df	11	-
t Stat	1.030904053	-
P(T<=t) one-tail	0.162360117	-
t Critical one-tail	1.795884819	-
P(T<=t) two-tail	0.324720234	-
t Critical two-tail	2.20098516	-

DISCUSSION

This research intended to influence a large population into adopting personal change to encourage energy consciousness. While an analysis of the findings concluded that there was no statistical difference in the average use of accessibility door systems by able-bodied campus goers across four sample locations, a general decrease in the misuse of the accessibility door systems was detected (*Table 2* and *Figure 2*).

One possible explanation for these results is that fewer people were observed using the passageways after the campaign was commenced. The total number of participants for the pre and post-campaign data collection periods are 2795 and 1192, respectively (Appendix 1). Lower quantities of pedestrian traffic imply that less people are capable of using the accessibility door systems. It is not clear why the total number of participants decreased during the latter phase of data collection, but one hypothesis has to do with the timing of the CBSM campaign. The

pre-campaign counts coincided with a busy time of the academic semester, meaning that it is possible that more academics were frequenting the sample locations as they are situated in major buildings and educational hubs housing multiple faculties on the Dalhousie Studley Campus. Comparatively, all post-campaign tallies were conducted after the Dalhousie winter semester study break which occurred from February 18 - 22. This might have influenced foot traffic as students, instructors, and professors were given time-off for academic purposes, meaning that participants might have had a reduced workload at the time resulting in fewer people on Studley Campus. This hypothesis, however, is limited to academia and excludes any non-academic variation in the number of participants such as building staff, supply deliveries, and retail employees. Additionally, this hypothesis assumes that the various academic schedules of participants observed at the sample locations are similar; in reality this is not the case.

Despite the CBSM campaign not yielding significant results towards behavioural change, there were important observations made about accessibility door use and their design. Sustainable behaviour is more likely when there are few barriers, such as infrastructure or bad habits (Manning, 2009). Accessibility doors were observed to be used more in the Killam Library than at other observed locations, most likely because of their weight, as stated above. Despite potentially having more information about the impacts of their behaviour, is there is a barrier preventing them from using this information, their behaviour will stay the same. If these doors remain too heavy for many people to comfortably use, they will continue to use the automatic doors, and may even develop a bad habit of using them in locations where they would be physically able to use the standard doors.

Aronoff et al. states that “The creation of a tangible link between environmental and economic impacts is crucial in producing substantial behavior change related to energy conservation” (2013, para. 7). The lack of an energy feedback mechanism could possibly explain why no statistical difference was found between the average use of accessibility door systems by able-bodied participants before and after the CBSM campaign. Providing feedback, such as quantifying the energy consumed or conserved by a certain practice through energy monitors, is known to be more effective in reducing energy consumption than merely providing information about how to save energy and creates personal energy awareness (Aronoff et al., 2013; Desrochers & Mosher, 2017). This research might have yielded a different result if energy feedback was incorporated into the experimental design.

CONCLUSION

In the future if further research were conducted, it would be beneficial to have more sample locations, researchers and time. If there had not been a time constraint, the project would've explicitly followed the community based social marketing campaigns framework from Doug Mackenzie Mohr's "Fostering Sustainable Behavior". Mohr's steps include: identifying the barriers to a behaviour, developing and piloting a program to overcome these barriers, implementing the program across a community and evaluating the effectiveness of the program (McKenzie-Mohr, 2019). However, the project does a sufficient job of capturing the essence of a CBSM campaign as is.

Dalhousie plans on being carbon neutral by 2050. The *"Campus Energy Master Plan"* states that this target will be achieved through a variety of methods, including recommissioning the current facilities by investing in operations to have systems at optimal efficiency (Dalhousie University, 2012). This should include an update of the doors, especially in the Killam Memorial Library, to reduce heat loss and encourage manual use. As a comparison, in 2012 Nova Scotia was the top province for reduction of wasted energy. The province reduced energy by just 1.5%, but the savings will amount up to $150 million in future electricity costs (Wies, 2013), showing that a small change can result in large gains.

ACKNOWLEDGEMENTS

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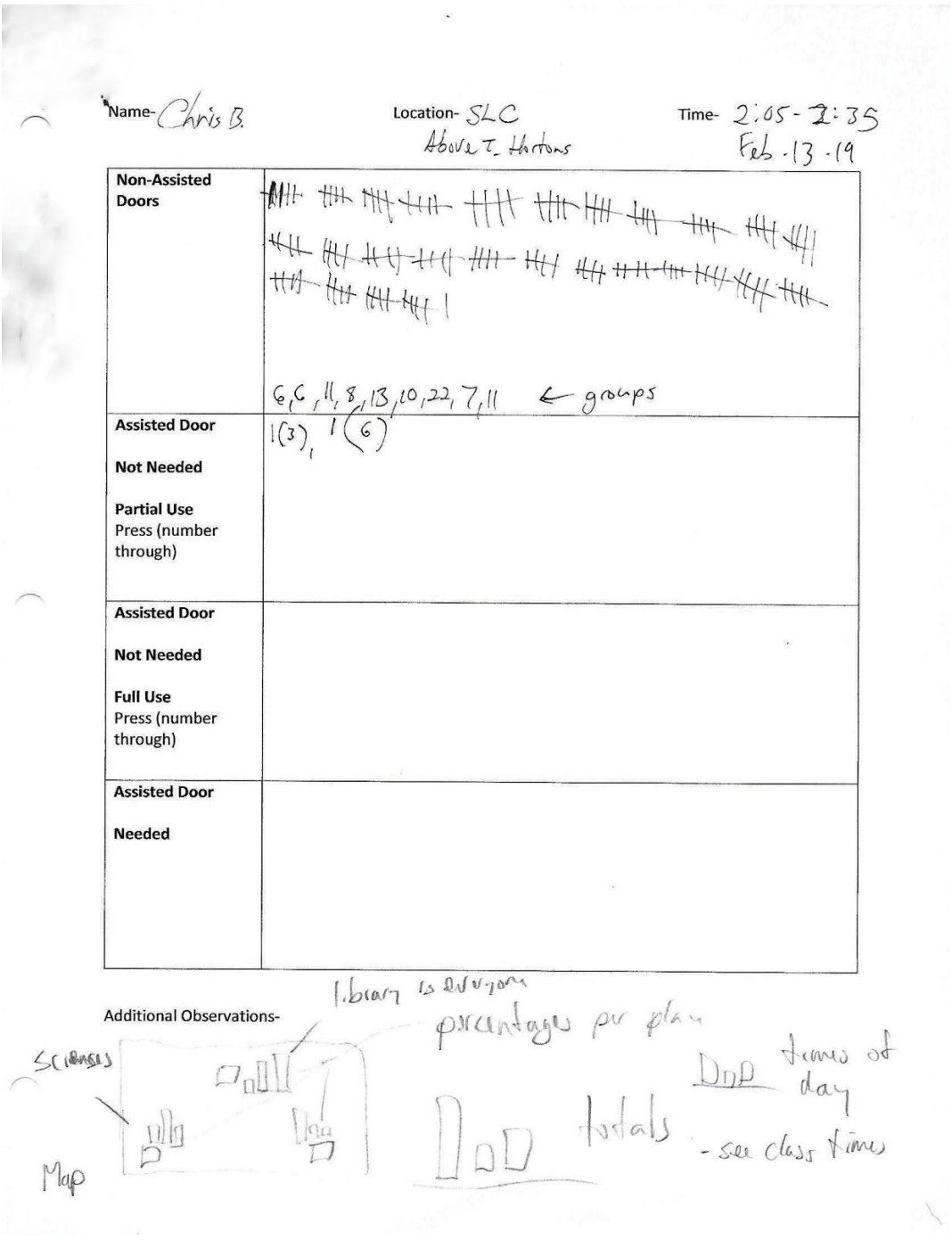
APPENDICES

Table 4 *Pre-campaign control counts*

Location	Killam Library (adjacent to Howe Hall)	3rd Floor LSC (above Tim Hortons)			Learning Commons (exterior)	Killam Library (Interior)		
Date	2/8/19	2/6/19	2/8/19	2/13/19	2/7/19	2/4/19	2/7/19	2/11/19
Time	10:17 - 10:47	15:15-15:45	9:32 - 10:02	14:05-14:35	16:00-16:30	14:00-14:30	14:00-14:30	14:00-14:30
Non-assisted Door uses	138	176	40	230	107	913	180	743
*button pushes: <5 people	18(44)	1(4)	1(1)	1(3)	0	10(43)	1(8)	0
*button pushes: >5 people	11(74)	0	0	1(6)	0	11(63)	1(1)	2(14)
Total Unnecessary Uses	29	1	1	2	0	21	2	2
Total persons unnecessarily using systems	118	4	1	9	0	106	9	14
Total persons appropriately using systems	0	0	0	0	0	3	0	4
Total people observed	256	180	41	239	107	1022	189	761

Table 5 *Post-campaign counts*

Location	Killam Library (adjacent to Howe Hall)	3rd Floor LSC (above Tim Hortons)		Learning Commons (exterior)	Killam Library (Interior)	
Date	3/15/19	3/13/19	3/15/19	3/21/19	3/18/19	3/21/19
Time	10:005 - 10:30	14:45-15:15	9:28-9:55	16:00-16:30	15:00-15:30	14:00-14:30
Non-assisted Door uses	67	51	42	96	428	220
*button pushes: <5 people	15(33)	0	0	0	10(97)	5(53)
*button pushes: >5 people	**9.5(64-84)	0	0	0	2(16)	1(7)
Total Unnecessary Uses	**24.5	0	0	0	12	6
Total persons unnecessarily using systems	107	0	0	0	113	60
Total persons appropriately using systems	0	0	0	0	5	3
Total persons observed	174	51	42	96	546	283



Name- Chris B. Location- SLC Above T. Hortons Time- 2:05 - 2:35 Feb. 13 - 19

Non-Assisted Doors	6, 6, 11, 8, 13, 10, 22, 7, 11 ← groups
Assisted Door **Not Needed** **Partial Use** Press (number through)	1(3), 1(6)
Assisted Door **Not Needed** **Full Use** Press (number through)	
Assisted Door **Needed**	

Additional Observations-

Figure 8 *A completed count sheet, following an observational period before the campaign was implemented*