UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

It's a sign: The impact of signage on water fountain usage at UBC

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Executive Summary

In collaboration with the SEEDS (Social Ecological Economic Development Studies) program at the University of British Columbia (UBC), this research project investigated whether water fountain signage installed by UBC SEEDs would generate a significant increased rate of water fountain usage in the Life Building at UBC. Two studies were conducted where study 1 consisted of a total of 985 observed patrons using the water fountains in the Life Building (LIFE) and Irving K. Barber Learning Center (IKB) and study 2 had a total of 50 participants complete an opinion survey. Study 1 consisted of four conditions in a between-subjects pretest-post-test design and Study 2 consisted of surveying individuals in regard to how the signage could further be improved. After signage installation and conclusion of data collecting, the multiple statistical analyses revealed that water fountain usage had not increased significantly. According to the feedback from the surveys, 48% of participants suggested to make the sign larger, 32% suggested to make it more colourful, 14% suggested to change the location and 6% suggested to add more signs. The practical implications of our findings stem from the need to improve signage and provides a review of signage design and placement.

Introduction

The University of British Columbia (UBC) has demonstrated their values for sustainability and accessibility by providing and expanding access to water sources. Prior research through UBC's Social Ecological Economic Development Studies (SEEDS) program suggested the need for signage in UBC's Life Building (LIFE) to further promote the use of water fountains. Four students enrolled in Environmental Psychology collaborated with a senior planning and sustainability engineer, Bud Fraser, through the SEEDS program to provide further insight.

Previous research has provided evidence for an increase in water fountain usage with the installation of signage. In a study done by Kenney et. al (2015), signage and cups were installed near water sources in 10 Boston public schools, where they found that this promoted water consumption across the student population. Their results suggested that providing water sources alone is an ineffective and inefficient way of increasing water fountain usage. The study instead emphasized the importance of addressing infrastructure and fixtures as an inexpensive strategy to promote the usage of water fountains.

Preceding this study, another SEEDS research project investigated the accessibility and the visibility of water fountains at UBC. Sané et al. (2018) found that at LIFE, despite the high-volume of foot-traffic, water fountain usage was low in comparison to UBC's Nest and UBC's Irving K. Barber Learning Center (IKB). Survey results indicated that there were difficulties in locating water fountains due to the lack of signage in LIFE. 86% of students indicated that the addition of signs would increase their use of water fountains.

Moreover, Cheng (2018) noted that at UBC, two-thirds of the drinking water outlets were not visible from the main entrances of the respective buildings. This observation suggested the subsequent need for signage to help increase the use of water fountains. To further emphasize the motivation of this study and to compare, signage stating "water bottle refilling station" were installed alongside at water fountains at the University of Victoria to encourage the use of personal water bottles (Cheng, 2018).

With the previous literature on this topic, we asked whether the water fountain signage installed by UBC SEEDS will generate a significant increased rate of water fountain usage in LIFE at UBC. Our hypothesis is as follows: the water fountain signage installed by UBC SEEDS will generate only a slight increase of water fountain usage after adjustment for covariates because the sign is not conspicuous enough to attract attention.

The slight increase in water fountain usage will be operationally defined as the increase in tallies from the pre-signage condition to the post-signage condition in LIFE in Study 1. Whether the sign is conspicuous enough to attract attention will be suggested by the findings from Study 2. As the experiment will be conducted during *Tap Water Awareness Week* at UBC, we will account for this by introducing a control group in IKB in order to compare the results from LIFE.

Methods

Participants

Study one. A total number of 985 UBC patrons were observed accessing the LIFE and IKB water fountains. Demographics were not calculated as it was a naturalistic concealed observation of a convenience sample. There was also a count separation to identify participants using the fountain to fill a water bottle or using it to drink.

Study two. 50 UBC patrons (27 males, 22 females, 1 preferred not to say) in LIFE were asked to complete an opinion survey. Each participant provided written consent to participate in this study. Subjects self-identified as Asian (46%), Caucasian (24%), other (16%), Middle Eastern (10%), Hispanic/Latino (2%) and African American (2%). Both studies were approved by the Principal Investigator.

Conditions

Study one. There were four conditions in this between-subjects pretest-posttest design study; location (IKB as control vs LIFE as treatment) x signage (pre-signage vs post-signage in LIFE.

Study two. This study simply consisted of surveying individuals in LIFE both using the water fountain to fill a water bottle and for drinking.

Measures

Study one. See Figure 3 for the sign set up in LIFE. Observations were scheduled Monday, Wednesday and Friday, 12:00-2:00pm and 4:00-6:00pm from March 4-15 for a total of 12 hours per week. A few adjustments were made due to scheduling issues where the Monday evening observation in IKB was done on March 18 and the Friday evening observation in IKB and LIFE was done on March 22. Usage was measured by the number of participants using the fountain (for bottle refill and drinking) during the specified hours (see Table 1 to 4). The response variable is the water fountain usage in both locations, while the explanatory variable is the signage posted in LIFE.

Study two. A Qualtrics survey (see Appendix A) was created to be administered in the Life building from March 18-22. The survey identified demographics, water bottle/fountain usage, sign efficacy and self-report recommendations from participants in the post-signage LIFE condition. The survey had to be created because no other survey had been created for this purpose.

Procedure

Study one. Naturalistic concealed observations were made during the specified hours in each location. A tally was kept for those who filled up a water bottle and for those who drank.

Study two. Researchers approached individuals who used the water fountain in LIFE during the specified hours. Participants were then asked to scan the QR code shown on an iPhone or Mac computer, that lead to the survey. Following the scan, subjects were free to take the survey on their own time.

Results

Analysis 1

A Two-Way Mixed Factor ANOVA was conducted to identify the relationships between intervention, location, and fountain usage (see Figure 4). For descriptive statistics, see Table 5. Firstly, there was no significant main effect of each signage condition irrespective of location ($F(1,4) = .83$, $p = .414$). Moreover, no significant interaction was found between signage and location ($F(1,4) = 2.72$, $p = .175$), meaning there were no significant differences in fountain usage between pre-signage IKB ($M = 110$, $SD = 9.54$), post-signage IKB ($M = 92.67$, $SD = 14.98$), pre-signage LIFE ($M = 60.33$, $SD = 5.03$), and post-signage LIFE ($M = 65.33$, $SD = 5.13$), see Table 6. There is a significant main effect between locations, irrespective of signage ($F(1,4) = 96.84$, $p < .001$), see Table 7. Although significant results are likely influenced by the small sample size obtained.

Analysis 2

A Three-Way Mixed Factor ANOVA was conducted to examine if signage influenced a specific method of water fountain usage (either water bottle refill or fountain drinking; see Figure 5 and Figure 6). For descriptive statistics, see Table 8. Results showed no significant interaction between signage and location ($F(1,8) = 3.16$, $p = .113$). In addition, there was no significant interaction between signage and method of usage ($F(1,8) = .09$, $p = .778$).

In addition, there was no significant interaction between signage, location, and method of usage either ($F(1,8) < .001$, $p = .979$), see Table 9. This means that there were no significant interactions between pre-signage IKB bottle refill ($M = 76.33$, $SD = 6.66$), pre-signage IKB fountain drinking ($M = 33.67$, $SD = 7.64$), pre-signage LIFE bottle refill ($M = 45.67$, $SD = 3.22$), pre-signage LIFE fountain drinking ($M = 14.67$, $SD = 8.02$), post-signage IKB bottle refill ($M = 66.67$, $SD = 13.05$), post-signage

IKB fountain drinking (M = 26, SD = 3), post-signage LIFE bottle refill (M = 47.33, SD = 1.53), and post-signage LIFE fountain drinking (M = 18, SD = 6).

In terms of between-subjects effects, we identified significant differences in location ($F(1,8)$ = 56.17, p <.001) and method ($F(1,8)$ = 195.54, p <.001) and a marginally significant main effect between location and method ($F(1,8)$ = 5.01, p =.056), see Table 10. These results suggest that fountain usage is significantly different between IKB and LIFE regardless of method and that method of usage is significantly different regardless of location. Lastly, the effect of method on usage varies by location, and the effect of location on usage varies by method.

Discussion

In this study we tested how new water fountain signage in LIFE would affect water fountain usage. It was previously indicated by Sané et al. (2018) that the issues in this building around water fountain usage were due to signage and that students agreed with this assessment; however, our results indicate otherwise. Results in both analyses indicated no significant relationship between water fountain usage and implemented signage, regardless of location or method. Despite this, main effects of location and method were found in the second analysis, suggesting that SEEDS should implement varying promotion initiatives to increase water fountain usage depending on the most commonly used method of usage per location. Specifically, our descriptive data shows higher means in all locations in both pre- and post-signage conditions for water bottle refill. Therefore, this data may be helpful in tailoring campaigns such as *Tap Water Awareness Week* towards promoting bottle refills, which students have been shown to do more frequently as a baseline.

Through surveying and general observation, our data indicated no significant link to any of the variables we tested, except for location. This could potentially call into question the practical implications of the signs that were installed, and their characteristics such as size, colour, and height. Our use of both survey and observational data along with the conducted analyses supports through their converging evidence that the signs did not have a sufficient impact on water fountain usage. The use of a control location in IKB allowed for a comparison to be made between the intervention (sign installation) and the absence of it. However, the limitation of our control could be attributed to the differences in the two buildings' establishments on campus thus impacting users' familiarity with the facilities. Our observed sample size of 985 was sufficiently high enough to draw conclusions and so was our sample size of 50 for survey data (though ideally these would have been closer in size). Moreover, analysis of the qualitative data gathered from the surveys requires improvement such as coding the content of the surveys as a refined operationalized measure.

This study carries implications for the use of plastics on campus through the behaviours surrounding reusable water bottle usage and the consumption of non-bottled sources. Through our data, the average hourly usage of the two fountains we examined can be surmised and potentially the ability to extrapolate this to other fountains on campus. As a result of differentiating between using the water fountain for bottle refill and fountain drinking, this can inform both the impact water fountains have on reducing plastic water bottle waste through use of reusable water bottles and through the general use of the fountains. This can also give insight into the water usage on UBC's campus at a per-fountain basis that can then prioritize maintenance and infrastructure supporting these areas with greater usage traffic. Finally, given the current epidemic of chronic lifestyle diseases (i.e., heart disease, stroke, diabetes, etc.) there are implications surrounding the number of high sugar drinks available on campus. Encouraging the choice of water could potentially be an avenue for future studies to explore in determining the long-term effect on health.

A number of confounding issues arose as a result of our study. Among the most pertinent factor is that there are a number of food service outlets in LIFE – and specifically in the same area where the water fountain is located. Furthermore, these stalls sold beverages, which likely reduces the interest or need for water. Another important confound is the fact that data collection was collected during promotions for Tap Water Awareness Week at UBC, encouraging drinking tap water, although we attempted to mitigate this with IKB as a control condition. This could have overestimated or underestimated our results given the reminders around campus to drink tap water. Moreover, for the survey component, our study lacked a double-blind experimenter component thus influencing potential experimenter expectancy effects as well as psychosocial effects in our interactions with the participants. Both factors undermine the internal validity. Similarly, individuals observing our survey data collection might have been more dissuaded to use the water fountain out of a lack of desire to interact with the researchers.

There were other more minor variables to account for as well, such as potential weather deterrents, which could be seen either as heavy precipitation or unexpectedly sunny weather that may cause lower or higher traffic than usual in the space, as well as affecting thirst levels. Though likely a minor background factor, but still a potential source for uncontrollable variation. Future study should aim to mitigate this by collecting data across all seasons.

Since our study was rooted in a naturalistic concealed observation, flaws remain the background variables that are difficult to isolate and control for, making it strenuous to separate the effects of which are unquantified. If this study were to be replicated, it would be ideal to identify these factors beforehand, and time providing, attempt to quantify them (i.e. measure how many drinks are being bought from food service locations in LIFE, map foot traffic pathways in the building, measure the average time spent in the buildings, etc.). Ideally, we also would have collected data over a longer period of time to measure if the sign installation had a greater effect over time. However, due to the time constraints of our study, having a longer study period and obtaining data on background variables was not practically feasible for our study.

Recommendations

After analyzing the survey data (N = 50), it was found that only 24% of participants noticed the sign, while 76% of participants did not. Subsequently, recommendations were given by the subjects who did not notice the sign. 48% of participants suggested to make the sign larger, 32% suggested to make it more colourful, 14% suggested to change the location and 6% suggested to add more signs. In regard to location change, subjects suggested lower signage placement as they felt it was too high and thus out of view. In terms of adding more signs, one subject suggested to put it on the wall across from the classrooms in LIFE.

The practical implications of our findings in its relevance to UBC stems from the need for improved signage and provides a review of signage design and placement. In the broader literature, our study potentially confirms some of the best practices while contradicting others. It is typically accepted that simple colours are best for this type of signage along with the sign being large with clear messaging and little text (Montuclard et al., 2017; UBC Digital Signage, n.d.). The sign installed conformed to neutral colouring, but was likely smaller than it should have been. It is not apparent how clear the messaging was to people and so it is impossible to assess this aspect.

Thus, our primary findings contribute to UBC in providing insight on the drawbacks of the current signage standards. This should reroute UBC's approach to continue being innovative sustainability leaders and maintain their path as outlined in their 20-Year Sustainability Strategy to embed sustainability throughout not only the community, but also through teaching, learning, research, operations, and infrastructure (UBC Sustainability, 2014). If signage can be improved upon in size and

tested again, this can continue UBC's 2013/2014 achievement of reducing water consumption by 35% (compared to year 2000) in campus buildings.

Given these implications, UBC's sustainability strategy, and our findings, we ultimately recommend that the sign be made larger, lowered to a more visible level as to rely on the nudge principle to incentivize the option of water fountain usage, and potentially make available an implementation of a wayfinding style of signage, such as would be found for bathrooms in a hospital, airport, or mall. This would effectively require the installations of more signs, but this cost would hopefully be beneficial to increase attention and awareness of water fountains, ultimately allowing for more sustainable consumption of water by UBC constituents. These recommendations could further be implemented in collaboration with a confound (*Tap Water Awareness Week*) that we found, by using it to an advantage as a periodic initiative to remind the community of responsible water consumption. In a similar manner heavy promotion of responsible water consumption (i.e., using a reusable water bottle) could be implemented through posters and canvasing around campus, as well as incorporating creative ways to induce normative social influence such that the perception of what the majority is doing as a way to conform sustainable behaviour. This could be achieved by posting statistics around the water fountains, vending machines, and more indicating that the majority of those at UBC use a water bottle and regularly refill at the water fountain.

We also recommend future studies to undertake the multitude of other buildings on campus in order to enhance overall reach of nudging water fountain usage. If more information is gathered on each individual building, a more tailored action plan can be pursued to further reach UBC's sustainability goals.

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Table 1
Tally count for Life Building pre-signage

	March 4 Morning	March 4 Evening	March 6 Morning	March 6 Evening	March 8 Morning	March 8 Evening
Water Bottle use	25	22	23	19	23	25
Fountain use	9	5	14	9	3	4

Table 2
Tally count for Life Building post-signage

	March 11 Morning	March 18 Evening	March 13 Morning	March 13 Evening	March 15 Morning	March 15 Evening
Water Bottle use	19	30	34	13	29	17
Fountain use	7	5	11	13	11	7

Table 3
Tally count for IKB pre-signage

	March 4 Morning	March 4 Evening	March 6 Morning	March 6 Evening	March 8 Morning	March 8 Evening
Water Bottle use	44	40	37	35	35	38
Fountain use	15	17	12	15	26	16

Table 4
Tally count for IKB post-signage

	March 11 Morning	March 18 Evening	March 13 Morning	March 13 Evening	March 15 Morning	March 15 Evening
Water Bottle use	28	25	42	37	41	27
Fountain use	8	15	9	17	14	15

Table 5
Descriptive Statistics for Analysis 1

Pre-Post Signage	Location	Mean	SD	N
Pre-Signage	0	110.00	9.539	3
	1	60.33	5.033	3
Post-Signage	0	92.67	14.978	3
	1	65.33	5.132	3

Table 6
Within Subjects Effects for Analysis 1

	Sum of Squares	df	Mean Square	F	p	η^2	ω^2
Pre-Post Signage	114.1	1	114.1	0.829	0.414	0.110	0.000
Pre-Post Signage ✻ Location	374.1	1	374.1	2.719	0.175	0.360	0.205
Residual	550.3	4	137.6				

Note. Type III Sum of Squares

Table 7
Between Subjects Effects for Analysis 1

	Sum of Squares	df	Mean Square	F	p	η^2	ω^2
Location	4446.8	1	4446.75	96.84	< .001	0.960	0.941
Residual	183.7	4	45.92				

Note. Type III Sum of Squares

Table 8
Descriptive Statistics for Analysis 2

Pre-Post Signage	Location	Method	Mean	SD	N
Pre-Signage	0	0	76.33	6.658	3
		1	33.67	7.638	3
	1	0	45.67	3.215	3
		1	14.67	8.021	3
Post-Signage	0	0	66.67	13.051	3
		1	26.00	3.000	3
	1	0	47.33	1.528	3
		1	18.00	6.000	3

Table 9
Within Subjects Effects for Analysis 2

	Sum of Squares	df	Mean Square	F	p	η^2	ω^2
Pre-Post Signage	57.042	1	57.042	0.964	0.355	0.079	0.000
Pre-Post Signage ✻ Location	187.042	1	187.042	3.161	0.113	0.259	0.126
Pre-Post Signage ✻ Method	5.042	1	5.042	0.085	0.778	0.007	0.000
Pre-Post Signage ✻ Location ✻ Method	0.042	1	0.042	7.042e −4	0.979	0.000	0.000
Residual	473.333	8	59.167				

Note. Type III Sum of Squares

Table 10
Between Subjects Effects for Analysis 2

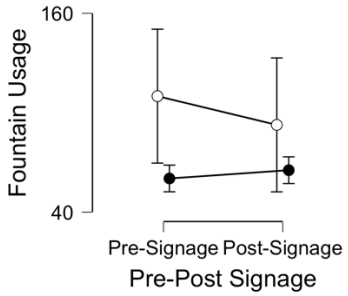
	Sum of Squares	df	Mean Square	F	p	η^2	ω^2
Location	2223.4	1	2223.38	56.169	< .001	0.212	0.208
Method	7740.0	1	7740.04	195.538	< .001	0.739	0.732
Location ✻ Method	198.4	1	198.38	5.012	0.056	0.019	0.015
Residual	316.7	8	39.58				

Note. Type III Sum of Squares

Figure 1. Location of Life Building Water Fountain.

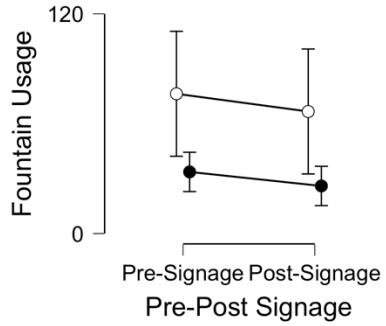
Figure 2. Location of IKB Water Fountain on the third floor.

Figure 3. LIFE Water Fountain with sign.



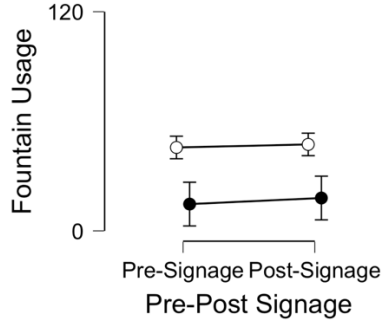
White: IKB | Black: LIFE

Figure 4. Two-Way Mixed Factor ANOVA.



White: Water Bottle | Black: Fountain

Figure 5. Three-way Mixed Factor ANOVA at IKB.



White: Water Bottle | Black: Fountain

Figure 6. Three-way Mixed Factor ANOVA at Life Building.

Appendix A
Water Fountain Usage and Demographics Survey

1. Did you notice the sign before we pointed it out? ☐ YES ☐ NO

   If you answered YES, why how you notice it?

   If you answered NO, what can we improve to increase visibility? (Select all that apply)
   ☐ Make it more colourful
   ☐ Make it bigger
   ☐ Change the location (Where would you put it? _____)
   ☐ Add more signs (Where else would you put it? _____)
   ☐ Other: _____
   _____

2. Do you own a reusable water bottle? ☐ YES ☐ NO

   If you answered YES, how often do you bring it with you on campus?

   If you answered YES, how many times a day do you refill your water bottle on campus?

   On a scale from 1-6, how frequently are you going to use this water fountain in the future after noticing the sign? (Please circle one)

   1 2 3 4 5 6

3. Why do you use water fountains?
   ☐ Convenience
   ☐ Refill water bottles
   ☐ Other: _____

Thanks for providing us with information! Please fill out the questionnaire below.

Please indicate your sex.

☐ Male ☐ Female ☐ Other ☐ Prefer not to say

Please indicate your age in years. _____ years old

Which category is the best representation of your ethnic identity?

☐ White/Caucasian
☐ East Asian
☐ Hispanic/Latino
☐ Middle Eastern
☐ African American
☐ Other (please specify): _____