How Informational Nudges Can Reduce the Overall Consumption of Paper Towels in a Collegiate Environment

by
Elijah Haines, Julius Winckler, Jieying Yang, Claire Zhou

Abstract

As the population rises and resources become more scarce, finding ways to conserve any and all resources is increasingly relevant. Areas with high population densities are an effective place to test how groups of people can be influenced to limit their consumption of resources. Bathroom behavior is not something most people are keen to talk about but understanding the rituals within that environment may hold a key to understanding overconsumption and waste. There are preconceived notions of what and how we are supposed to do after finishing our “business”. People have expected behaviors and planned behaviors both of which dictate what they will do in most given situations. Our goal was to see if we can effect those behaviors.

Introduction

In many day to day activities there are certain behaviors that are hard wired habits: things that we do everyday without realizing that we are actually doing them. A great example of this is when we use the bathroom, regardless of why we use the bathroom it is social edict that we wash our hands after we are done. For many people that means running your hands under water, then grabbing a couple of paper towels to dry your hands off, throwing them in the trash and going about your day. In our experiment we would like to investigate if we can make people take just one paper towel to dry their hands instead of a couple. Can we change this predetermined behavior by providing them with the right information at the right time?

Hypothesis

People don't know how to properly use paper towels. We will significantly reduce the amount of towels used if we inform them about the techniques that make it possible to dry their hands with just one towel.

Literature Review

After our literature review we had certain areas that peaked our interest in the selected resources. We were first interested in Richard C. Stedman's paper [1] on the impact a place can have on a person's behavior. While that particular article was intriguing in that it focused on, *"cognitions, attitudes, identities, and behavioral intentions located in and fundamentally about place. A survey of property owners in Vilas County, Wisconsin, revealed the importance of symbolic meanings as underpinning both place satisfaction, conceptualized as an attitude toward a setting, and attachment, conceptualized as personal identification with a setting. In turn, attachment, satisfaction, and meanings all have independent effects on willingness to engage in behaviors that maintain or enhance valued attributes of the setting*." While his focus was on housing our question was, do the same principles apply to other settings in a person's life?

Our second area of interest that helped to shape or experiment was Florian Kaiser, Gundula Hubner, Franz Bogner's research on "contrasting the value-belief-norm (VBN) model and the theory of planned behavior (TPB) for the first time regarding their ability to explain conservation behavior." The main principle that we took from this paper was The Theory of Planned Behavior discussed in the paper. What was most interesting to us was *"For the theory of planned behavior (TPB), the original determinants—attitude, subjective norms, and perceived behavioral control—account for 76% of people's intentions, which in turn explain a stunning 95% of the variance in conservation behavior."* [2] We felt if these factors were responsible for 76% of people's intentions was there a way to influence a change in how people went about their planned behaviors when it pertained to conservation in some way.

We came to the conclusion that one place that would include both of these aspects, the TPB and how a specific place can elicit specific behaviors simply by what they are, would be the restroom. People have a almost unconscious planned behavior when they use the restroom and there are certain behaviors that are expected when one uses the bathroom. So we thought how much do people actually think about their bathroom behavior/routine? Can we influence that behavior/routine with a specific nudge and make people more aware of conservation while in the restroom?

Methodology

Recruiting

All participants were unaware that they were being monitored for any period of time. The only inference they may have made for being part of this study was the appearance/disappearance of the signage used in the bathroom.

Demographics

Most participants would be assumed to fall within the range of the average collegiate student (18-25) with a negligible proportion consisting of staff, teachers, and students outliers.

Limitations

Due to a lack of hardware, we were only able to gather data from four dispensers. We chose to monitor the busiest bathrooms (male and female) on the ground floor, installing sensors in two dispensers each. When given the option, we opted for the dispensers closest to the door since they experience the highest usage. The collected data was limited to a timestamp and the amount of towels taken per user. For the second part of our experiment, we used one nudge to affect the behaviour of the people using the bathroom.

Study setup and testing methods

Recording devices were installed in two of the paper towel dispensers closest to the door in the two largest boys and girls bathrooms, on the lower level of the school.

Each Arduino setup consisted of an Arduino Uno, an Arduino Shield (for Micro SD card), a snap action micro switch, and a 2200 mAh power bank. Each unit would measure the single rotation required for the withdrawal of one paper towel within the paper towel dispenser and recorded the timestamp of the interaction. (see Fig. 1) Every towel pulled within a 3 second interval was counted towards a single user.

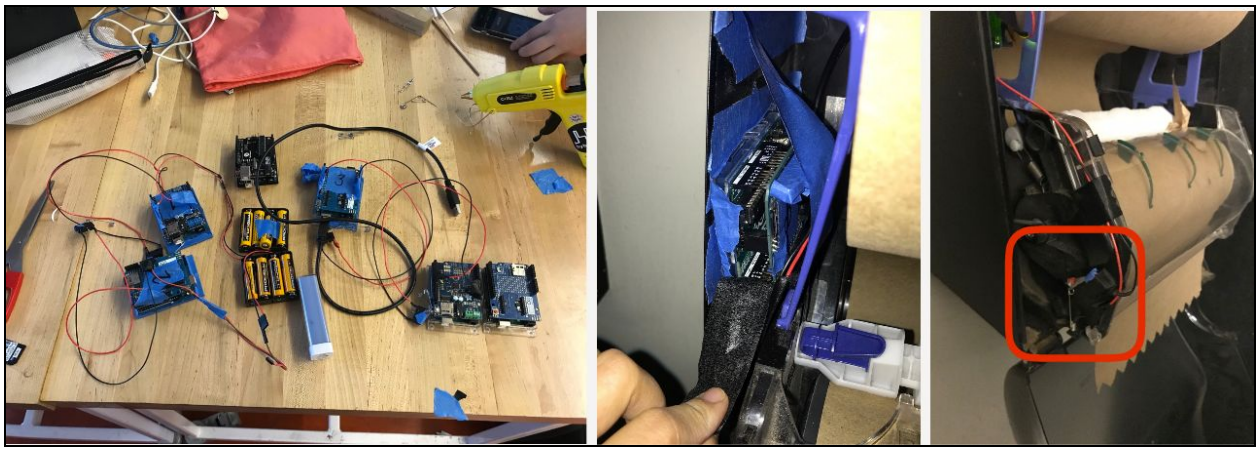

Figure 1. Setup of the sensors in the paper towel dispensers.

The initial anticipated run time for the test was two weeks total (one week without nudging and one week with the nudge implemented). The actual run time was 3 days without and 2 days with the nudge.

The nudge consisted of informational signs (see Fig. 2) informing people that they should shake their hands after they wash them and to fold each paper towel in half so that the paper towel would work better via capillary effect.

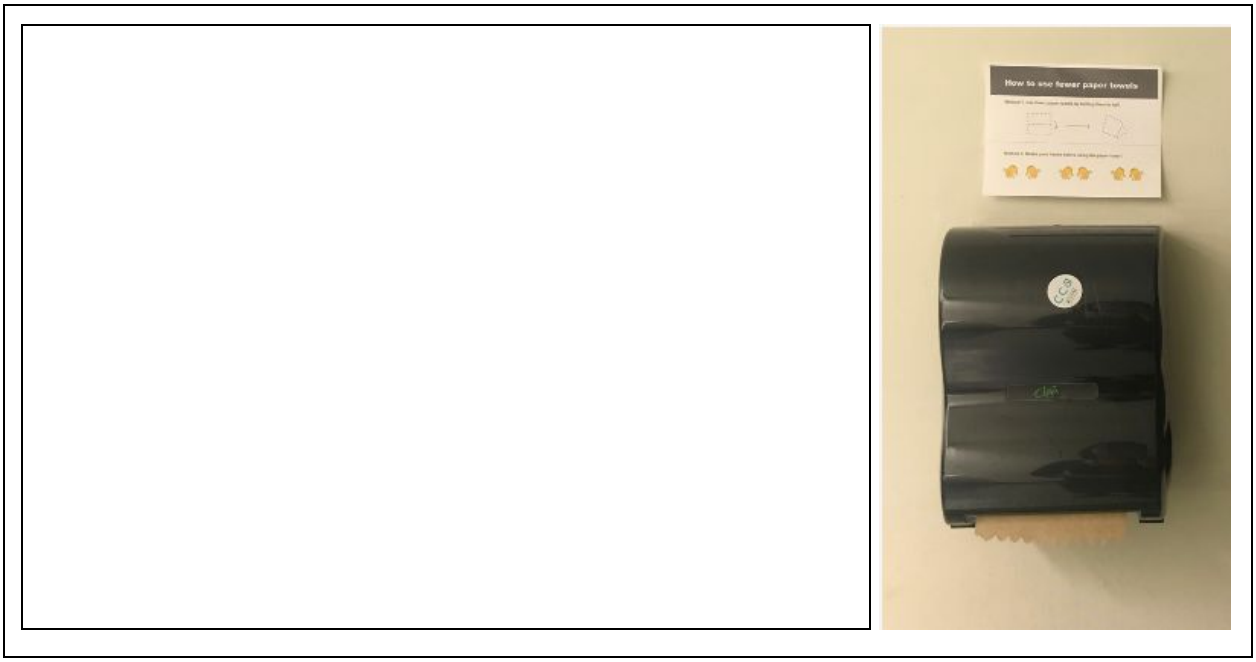

Figure 2: Nudge installed in the bathrooms for the second phase of the experiment

Data analysis / synthesis process

The text files created by the sensors were transferred to Excel sheets after stripping them down to just the relevant numbers. Every dispenser's data was fed into an individual sheet and one combined document for Male/Female bathrooms. The actual time of each interaction with the paper towel dispenser was calculated by adding the runtime to the install time. This way, usage patterns over the day could be visualized. (See Fig. 3)

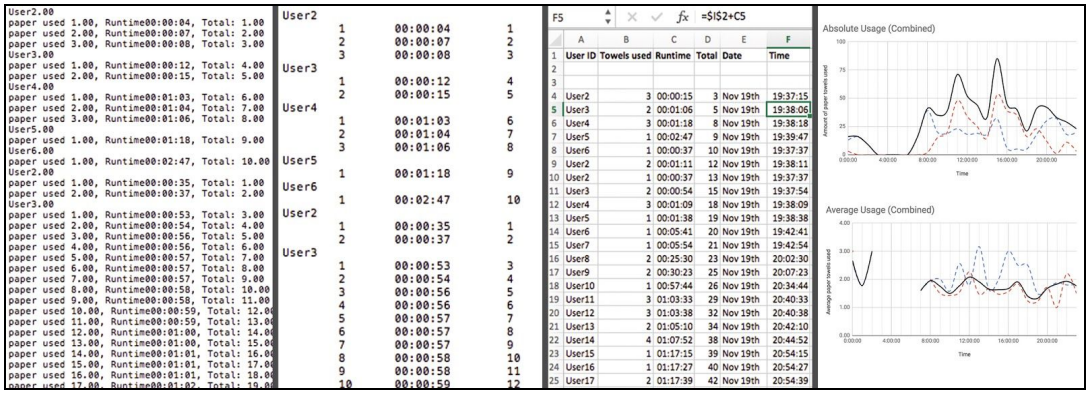

Figure 3 : Synthesizing the raw data from the arduino into a spreadsheet

A critical factor for the amount of towels used per person is the time between the withdrawal of each towel. A later analysis of the data (before installing the nudge) confirmed this decision: Almost all towel pulls happened within three seconds or more than ten seconds. Just 6% of all data collected falls between the two time frames. (fig. 4) This way it was possible to also accommodate for high traffic times where two users used the same dispenser in rapid succession.

Delta (s)	Occurrence	Percentage
0	78	9.54%
1	211	25.79%
2	75	9.17%
3	37	4.52%
4	18	2.20%
5	6	0.73%
6	8	0.98%
7	4	0.49%
8	5	0.61%
9	6	0.73%
10	2	0.24%
>10	374	45.72%
Total	**818**	**100.73%**

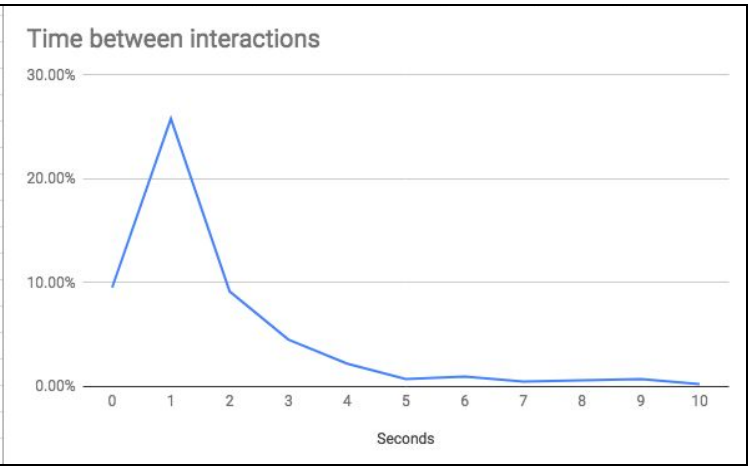

Figure 4: Distribution of times between each pull of a paper towel,

Findings

During our test, we recorded a total of 466 users using 788 towels in 188 hours of runtime. While most users were recorded in the female bathrooms, most towels were used in the male bathrooms, with a significantly higher towel/user ratio before the introduction of the nudge. (See Fig. 5)

	Overall Stats							
Pre Nudge	**Gender**	**Total Users**	**Total Towels us**	**Towels / User**	**Uptime**	**Uptime (min)**	**Users / Hour**	**Towels / Hour**
	Female	206	332	1.61	80:21:34	4822	2.56	4.13
	Male	195	376	1.93	72:38:38	4359	2.68	5.18
	Average	401	708	1.77	153:00:12	9180	2.62	4.63
Post Nudge	Female	46	57.00	1.24	18:21:57	1102	2.50	3.10
	Male	19	23	1.21	16:47:02	1007	1.13	1.37
	Average	65	80	1.23	35:08:59	2109	1.85	2.28

Pre Nudge	
Runtimes F	**Runtimes M**
27:53:05	27:00:16
0:47:25	9:57:53
30:40:34	19:57:41
21:00:30	0:18:15
	15:24:33

Post Nudge	
Runtimes F	**Runtimes M**
18:21:57	16:47:02

Total	
Uptime	188:09:11
Uptime (min)	11289
Users	466
Users / h	2.48
Towels	788
Towels / h	4.19

Figure 5: The overall statistics of the experiment

Figure 6. shows the total amount of paper towels used over the period of one average day before the introduction of the nudge. There are some clear spikes around 11:00 AM and 3:00 PM which match up with the break times at CCA. Interestingly, the male usage sees a spike during the morning hours while the female bathrooms don't.

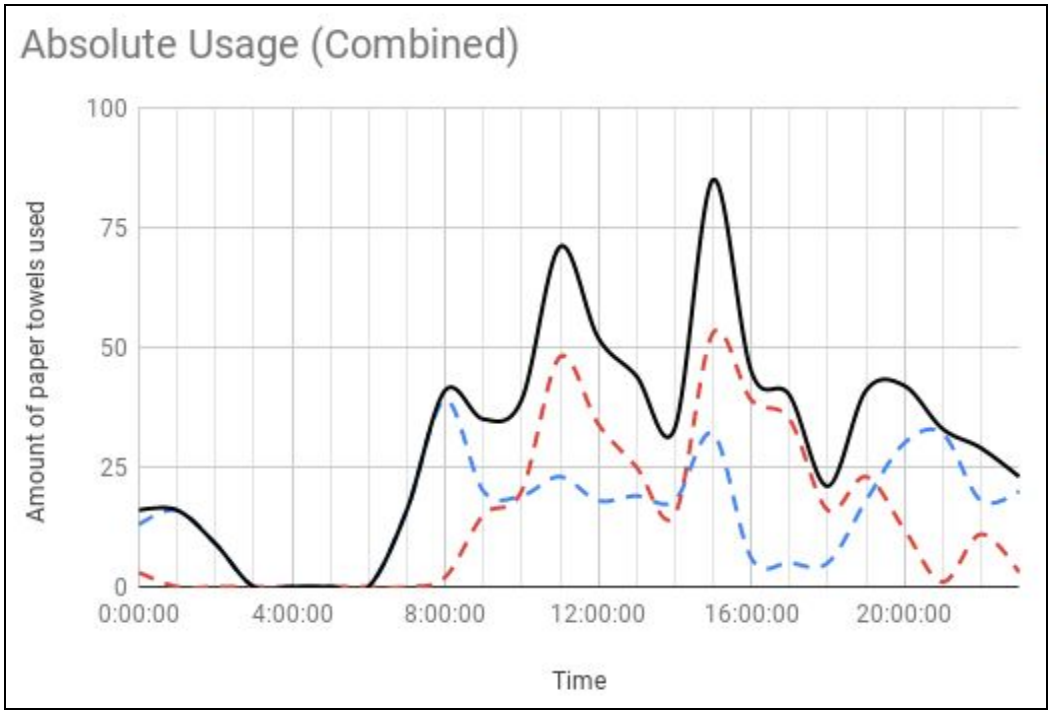

Figure 6: The total amount of paper towels used per person. Female numbers are plotted in red, male in blue, combined numbers in solid black

When examining the average amount of towels used, we could not identify any clear patterns. There seems to be a higher average after midnight, which might hint at people being more

careless during the night hours. However these numbers might be skewed as the total amount of interactions recorded was rather low. (See Fig. 7)

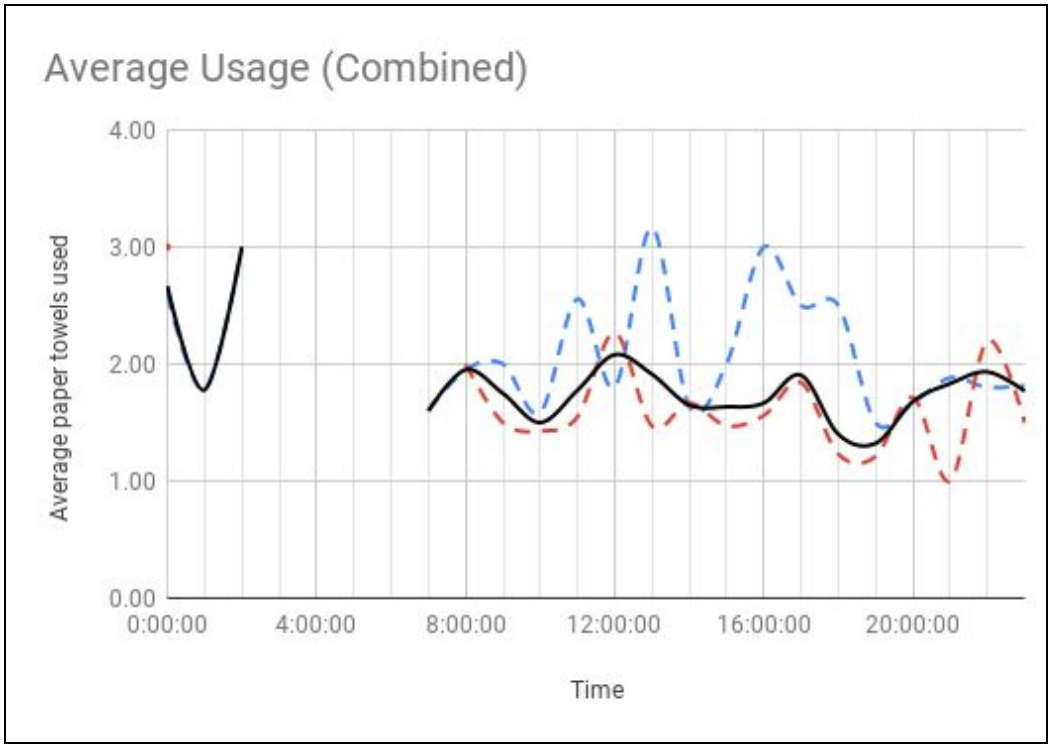

Figure 7: The average amount of paper towels used per person. Female numbers are plotted in red, male in blue, combined numbers in solid black

After the introduction of the nudge, we compared the data of individual usage between the male and female bathroom. The result shows clear improvements both in the male and the female restroom. We can see significantly more people using just one towel in the female bathroom. In male's bathrooms the amount of people who are using 3 or more towels was cut in half.

By just providing information on the techniques that make it possible to dry your hands using just one towel, the data shows 40% more people are using just one paper towel while 30% less people are using 3+ paper towels. (See Fig. 8 and 9)

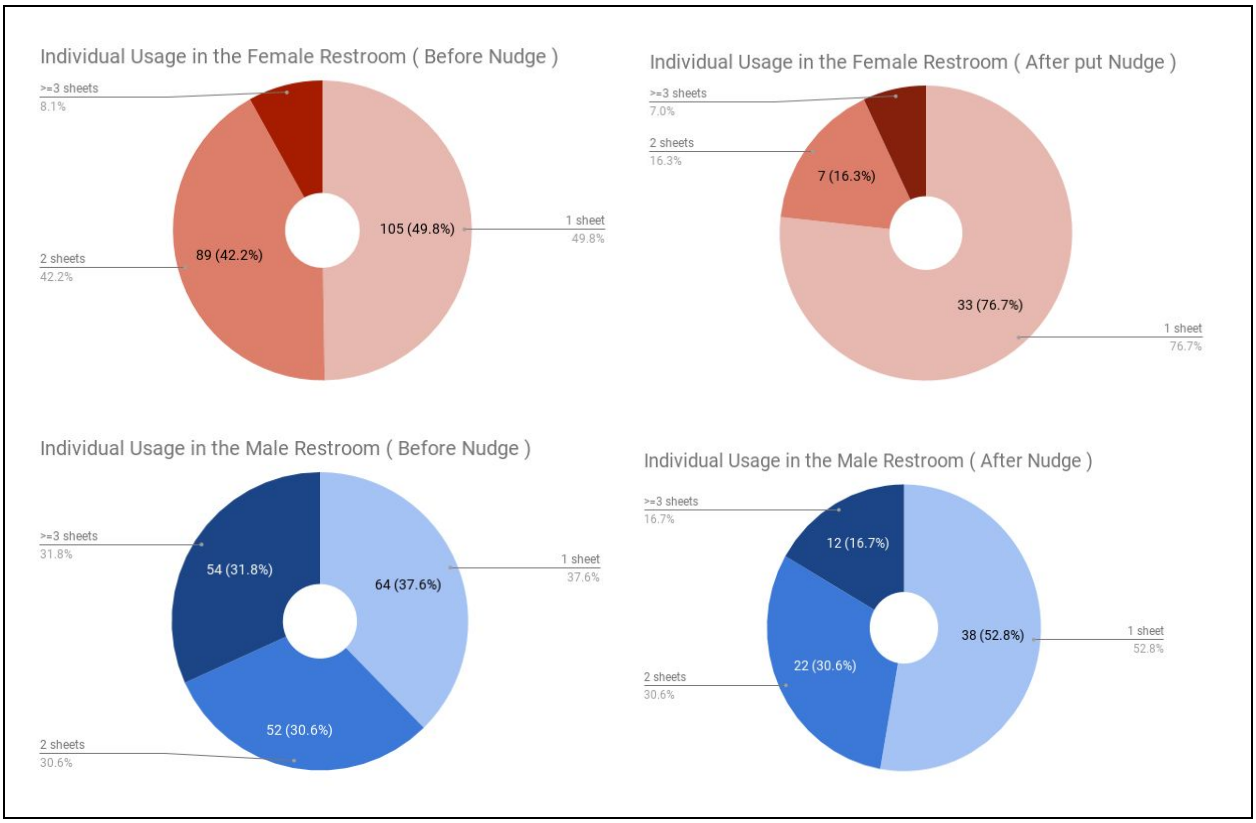

Figure 8: Comparison of the amount of towels taken before and after the introduction of the nudge, split by gender

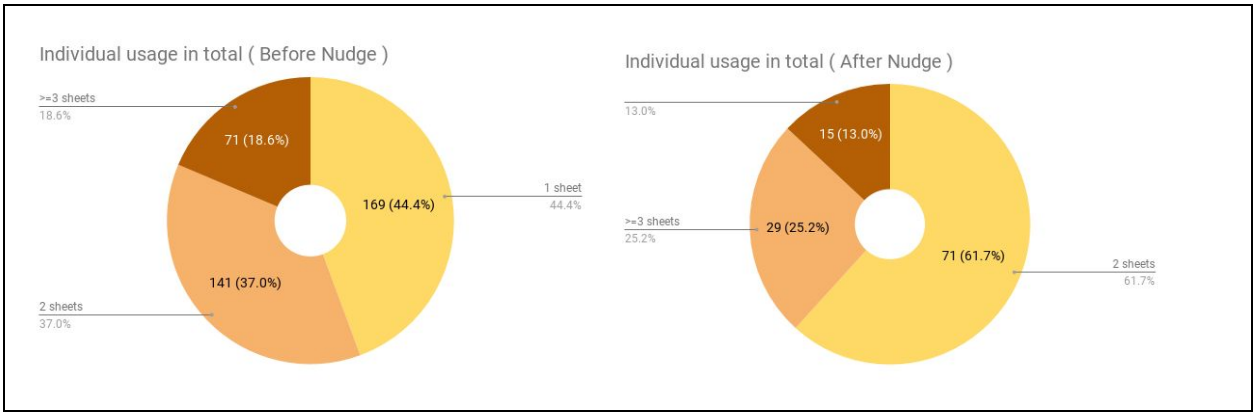

Figure 9: Comparison of the combined amount of towels taken before and after the introduction of the nudge

Discussion (suggestion)

Given the previous statistics we found for paper towel consumption [4,5] we believe that this particular subject is worth exploring further. If the nudging was successful, incorporating the findings from it would be impactful on many levels.

The data does show the amount of two and three paper towel usage reduced, however because the device only collected four days of data, there was not enough data for us to give a conclusive evidence that our hypothesis was correct. we do believe that the data we were able to collect shows that we have enough evidence to run the test again. While we were able to collect a fair amount of data, the experiment was not run for a long enough time, a longer run time would give much more conclusive results. In the short time frame of the experiment three of the most meaningful findings were: ~0.5 less towels per person, ~40% more people using only one towel, ~30% less people using 3 or more towels. We also found possible interesting correlations between time of day and the amount of paper towels used (early morning and late night are when people use the most towels per person).

If these numbers were to remain the same over an extended amount of time (i.e the whole semester) the impact for CCA could be significant. The effects could be substantial, not only monetarily but from a ecological vantage point as well. Reproducing this experiment at CCA and having it run over a semester would be beneficial for CCA's belief in progressive sustainability and also for the overall optix to students. Showing the students they can make a positive impact on their school using the techniques they have learned within their major.

Future work/next steps

We believe that if this test was implemented on a larger scale with more time, we would be able to prove more conclusively that there is a clear correlation between the introduction of our informing nudge and eliciting a change in planned behavior. With a longer running test we believe that we could not only change the behavior towards conserving paper towels but also save CCA money and reduce their environmental footprint. After the test run, the hardware bought for this test could then be given to the Hybrid Lab for further student use.

Acknowledgements

We would like to thank Haakon Faste for helping us through the entire process. We would also like to thank the maintenance and facilities staff for allowing us to place sensors in their work areas and making sure that the devices were not tampered with or disturbed in any way. Lastly we would like to thank Aaron Soloway for helping with the code for the Arduinos that allowed us to collect our data.

References

1. *Environmental Attitude and Ecological Behaviour*
   NeuroImage, Academic Press, 25 May 2002,
   www.sciencedirect.com/science/article/abs/pii/S0272494498901074.

2. Florian Kaiser-Gundula Hubner-Franz Bogner:
   Contrasting the Theory Of Planned Behavior With the Value-belief-norm Model in Explaining Conservation Behavior
   Journal Of Applied Social Psychology - 2005
   https://doi.org/10.1111/j.1559-1816.2005.tb02213.x

3. Richard C. Stedman:
   Toward a Social Psychology of Place: Predicting Behavior from Place-Based Cognitions, Attitude, and Identity
   Research Article First Published September 1, 2002
   https://doi.org/10.1177/0013916502034005001

4. *Drying Hands: User Preference*
   (Intermetra Study - 2008), European Tissue Symposium
   https://www.europeantissue.com/about-tissue/away-from-home/properties-of-tissue/user-preference/.

5. Amos Mushala:
   Paper Awareness
   Better Planet Paper, Inc.
   www.betterplanetpaper.com/uearn2/Paper-Awareness.