# How Does the Presence of a Plant Influence Waste Sorting Behaviour

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## Executive Summary

This study aims to investigate whether the presence of a plant near indoor waste disposal bins impacts correct waste sorting. We hypothesized that participants exposed to a plant, as opposed to those in the control conditions, will have a higher percentage of items sorted correctly into disposal bins. By employing a convenience sampling method, we included 167 participants in our study. We observed participants in one of the following conditions: a no-object control condition, a green flag control condition, and a plant condition. During the observation, we recorded the total number of items each participant disposed in each bin, as well as the number of items correctly and incorrectly sorted. Contrary to our hypothesis, the plant did not significantly improve waste sorting when compared to control conditions. Participants in the plant condition had the lowest average percentage of items sorted correctly, followed by those in the no-object condition and then the green flag control condition. However, mean comparison and marginal significance point to the possibility that a green flag may improve waste sorting. Implications and recommendations for UBC regarding the application of the plant and the flag are also discussed.

## Introduction

Given the current dramatic changes occurring in the natural environment across the world such as extreme weather, rising sea levels, and increasing surface temperatures (Zhao, 2015), sustainability has become a topic of great importance to the global community. Sustainable behaviours can contribute both directly and indirectly to improving the current environmental situation ("Reducing and Reusing Basics," 2015). It is therefore crucial that efforts focus on promoting or facilitating more sustainable human behaviours.

Some approaches for facilitating more sustainable behaviours focus on the individual and others on the external environment. For example, one approach for altering our behaviour on an individual level is through the restructuring of our attitudes. Schultz (2000) has found that by taking the perspective of an animal being harmed by pollution, individuals increased their levels of biospheric environmental concern (which is based on a value for all living things) as compared to those who remained objective. Furthermore, as revealed in the study by Wu, DiGiacomo, and Kingstone (2013), individuals in a building designed to promote sustainability were significantly more likely to sort waste items into the correct bins than those in a building without such a design. These findings provide support for how changes at an individual level and in our external environment can facilitate more sustainable behaviour.

One individual approach is to improve waste sorting behaviour, which has several direct effects on current and future environmental conditions. For example, less recycling means that more paper and plastic products need to be manufactured from scratch. Paper manufacturing is directly related to deforestation, which not only rids several species of their habitats and may lead to their extinction, but also directly contributes to global warming by causing higher levels of greenhouse gasses in the atmosphere ("Impacts of Pulp and Paper," n.d.). The manufacturing process for plastic products such as water bottles also contributes significantly to levels of greenhouse gasses in the atmosphere ("Reducing and Reusing Basics," 2015).

The present study was partially inspired by the research conducted by Van der Wal, Schade, Krabbendam, and van Vugt (2013), which focused on future discounting, one of the five evolutionary tendencies that contribute to the damaging interactions that humans have with our current natural environment (Griskevicius, Cantú, & van Vugt, 2012). The researchers presented evidence for how exposure to natural landscapes as opposed to urban ones may cause people to place more value on the future as a function of lower discount rates. It is possible that this increase in value placed on the future may manifest itself through individuals' immediate behaviours, which raises the question of whether the presence of a plant near indoor waste disposal bins impacts correct waste sorting. As exposure to scenes of nature invokes greater value of the future, we believe that the presence of a plant will improve sustainable waste sorting behaviour. Thus, we hypothesized that participants exposed to a plant, as opposed to control conditions, will have a greater average percentage of items sorted correctly into disposal bins.

## Methods

### Participants

The participants for the present study were students, faculty, and staff members from the University of British Columbia. Participants were selected based on a convenience sampling

method; each person who disposed of waste at the observed bin station during the data collection period was recorded as a participant.

## Design

We collected data over an 8-day period, during the hours of 11am to 1pm. We observed participants in either of the four conditions: a no-object control condition (C1; $n = 39$), a green flag condition (F; $n = 46$), a plant condition (P; $n = 50$), and a final no-object control condition (C2; $n = 33$). Over the eight-day data collection period, the conditions occurred as follows, C1: days 1 and 2, F: days 3 and 4, P: days 5 and 6, C2: days 7 and 8 (see Appendix A, Figure 1). In total, each condition was observed for four hours. We observed the same bin station in all four conditions. A bin station consists of four different compartments for the disposal of food scraps, recyclable containers, paper, and anything left (trash) (see Appendix A, Figure 2).

## Object Descriptions

The plant that we used in the present study was a 1.3 meters tall Monterey Cypress tree (see Appendix A, Figure 3). The flag, also 1.3 meters tall, was constructed using a white cardboard box as a base, a rounded, thin wooden pole, and a solid piece of green construction paper (see Appendix A, Figure 4). We placed each object in the gap between the four bins (see Appendix A, Figure 2), but positioned them so that they were visible to participants approaching from both sides.

## Controls

The purpose of the F condition was to control for the presence of a green object, ensuring that any effects seen were not the result of just viewing the color green on an object placed by the bins. A flag was chosen because it is a man-made object that does not originate in nature, and generally not symbolic of nature. Nature is specifically defined to exclude any objects that are created by humans ("Nature," n.d.). The C2 condition was used to rule out any event that may have occurred outside of our experiment after the C1 condition as contributing to the changes in sorting behaviours observed during the P condition. Possible external events that could have contributed to a change in waste disposal behaviour may include such things as the introduction of posters around campus that urge people to recycle or compost more. If such an event had occurred, we would have seen an improvement in waste sorting between the C1 and the C2 conditions.

## Rating System

For each participant, we recorded how many items a participant disposed of and whether each of those items was placed in the correct bin (see Appendix A, Figure 5). We determined a participant's correct sorting percentage by the percent of the items placed in the correct bins. For example, if a participant disposed of three items and two items were placed in correct bins, but the third was not, the participant sorted 2/3 items correctly and their correct sorting percentage would be 66% or .66. Two observers were used in every condition to ensure that data was accurately recorded. We participated in a pilot study together, so that we were in agreement

about what items should go in which bins, ensuring inter-rater reliability. Interrater reliability was crucial for the present study, because it involved more than one observer and relied heavily on our subjective judgments to determine whether an item was sorted correctly. We obtained our general guidelines for sorting items into waste disposal bins from UBC Sustainability's Sort it Out Guide ("Sorting Guide," n.d.) (see Appendix A, Figure 6).

## Results

To address the hypothesis of whether the presence of a plant as compared to a flag or nothing increases the average percentage of correctly sorted waste, a one-way between group ANOVA was conducted. Furthermore, since the hypothesis was directional, planned contrasts were also conducted between the plant and the flag conditions, the plant and the flag conditions, and the plant and both the flag and control conditions. A contrast between the flag and the control conditions was also conducted to determine whether the effect of the flag was comparable to that of nothing, and thus whether the flag could be viewed as a true control. In addition, no significant difference was found between the C1 condition ($M$ = .62, $SD$ = .44, $SE$ = .08) and the C2 condition ($M$ = .78, $SD$ = .39, $SE$ = .07; $t(32) = 1.60$, $p$ = .12), thus, for the analysis the two conditions were combined to form a single control condition (C). See Appendix B, Table 1 for descriptive statistics.

Overall, no significant difference was found between the conditions, $F(2, 164) = 1.27$, $p$ = .28. However it was found that the average percentage of waste sorted correctly for individuals in the P condition ($M$ = .70, $SD$ = .42, $SE$ = .05) was lower than the average for those in the F condition ($M$ = .81, $SD$ = .35, $SE$ = .05), although this effect was non-significant, $t(164) = -.40$, $p$ = .69. Similarly, those in the P condition had a lower average percentage of correctly sorted waste as compared to those in the C condition ($M$ = .78, $SD$ = .35, $SE$ = .05), but this effect was also non-significant, $t(164) = -1.10$, $p$ = .27 (see Appendix B, Figure 7). Furthermore, when compared to both the F and C conditions, individuals in the P condition had a lower average percentage of correctly sorted waste, but again this effect was non-significant, $t(164) = -.35$, $p$ = .73. These findings oppose the study's hypothesis, as they suggest that the presence of a plant had no significant effect on the average percentage of correctly sorted waste.

Lastly, when compared to the C condition, it was found that those in the F condition had a greater average percentage of correctly sorted waste, and this effect was found to have been marginally significant, $t(164) = 1.50$, $p$ = .14. This finding indicates that the presence of a flag may have facilitated correct waste sorting as compared to nothing. This in turn suggests that the flag did not serve as an adequate control as it was found to have had a marginally significant effect on waste sorting behaviour (see Appendix B, Table 2 for significance table).

## Discussion

Our results suggest that the presence of a plant does not have an effect on correct waste sorting behaviour and, therefore, did not have an impact on environmentally sustainable behaviour. The non-significance of our results may have been due to various challenges and limitations. One particular challenge we faced was the small sample size obtained through a convenience sampling method. Our experiment analyzed 167 participants, which may not be a large enough sample to uncover significant results. The small sample size limits the statistical

power of the investigation and, therefore, limits our ability to detect a real effect if, in fact, one does exist.

Further limitations include the manipulation of our independent variable, which was the presence of a plant. The plant, a young cypress tree, was strategically placed in the middle divide of the sorting bins so as not to be an obstacle to those who approached the bins, but remain easily visible when approaching the sorting station from any angle. However, the presence of only one plant may not have created the required saliency to elicit an effect in sorting behaviour. Our lack of significant results may be due to the fact that mental schemas involved in the processing of natural settings or stimuli were not sufficiently activated by one plant. Since past studies used exposure to full natural landscapes, it is plausible that simply having one plant may not have been sufficient to achieve the desired results. Furthermore, unlike past studies we have no record of how long a participant viewed the plant. These past studies had participants focus on pictures of natural landscapes as they appeared on a computer screen (Van der Wal et al., 2013). It may be that participants simply did not focus on the plant long enough for them to consider the connection between the plant and the impact their sorting behaviour will have. In future studies, it will be important to develop and design a more prominent and pronounced plant presence, one that attempts to guarantee conscious awareness on behalf of the participants and ensures time enough for consideration of the connection between the plant or plants and the disposal of the waste.

An interesting result to note is the high average correct sorting percentage in the green flag condition, which was initially intended to control and ensure that the effects seen would not be due to merely viewing the color green on any non-plant object. The flag was specifically chosen to not be reminiscent of plants or nature. However, as mentioned in our descriptive statistics, the green flag observed the highest correct sorting score and may have actually improved correct sorting behavior. We suspect that while a plant can be seen as a common form of decoration and therefore, nothing of great significance, the nature of a flag is to draw one's attention and to communicate some sort of significance ("Flag," n.d.). It is therefore plausible that the participants thought that the flag signified something important about the bins and this may have enhanced awareness of both the bins and the situation, leading them to focus more on the sorting of their waste. Further exploration should investigate the possibility of flags improving waste sorting behaviour.

Some further limitations stem from the manner of data collection. As noted before, all observers participated in a pilot study to ensure that all were in agreement about what items went in which bins. However, due to a great variety of waste items it was not possible to ensure that all items were accounted for in the pilot study. This indicates that results from the data may have been masked by differing opinions amongst the observers about where certain items should be sorted. Furthermore, the fact that some participants bundled their trash or threw away very small objects meant that not all disposals could be recorded, because they were simply not visible to the observers.

Suggestions for further research include looking at whether or not participants actually attempted to sort and whether this might be impacted by the presence of a plant. It is possible that in some instances participants actually attempted to sort, suggesting the intention to perform a sustainable behaviour, but due to any variety of reasons they sorted their items incorrectly. In the case of the current study, we are unable to accurately discern those who simply chose not to sort from those who did intend, but did so incorrectly. If most participants did actually intend to

sort, then we would recommend looking into better bin designs for informing people about what goes in each bin as an approach to improving correct sorting behaviour.

## Recommendations for UBC

Over the past couple of years, UBC has developed initiatives through its Zero Waste Action Plan that are designed to move UBC towards a "Zero Waste" campus, in which all waste items become reusable resources and are not sent to the landfill. The plan includes several actions and projects, such as a series of pilot studies like the introduction of the four-stream recycling stations (see Appendix A, Figure 2). At the moment, UBC diverts 45% of the waste it collects during daily operations from the landfill to be reused. However, it seeks to have a diversion rate of 70% by 2016. Such an increase in diversion will require significant improvements in waste sorting behaviour. Our project is designed to be one approach towards improving this behaviour. ("Waste Action Plan", n.d.)

To more thoroughly investigate the possibility that a plant will positively influence the waste sorting behaviour of people on campus, we recommend that UBC replicates this study with a few changes. Firstly, we suggest that UBC attempts this study with a larger sample size to improve the ability to detect an effect. Secondly, we recommend that UBC replicates this study while putting greater emphasis on the saliency of the plant presence. While one possible way of doing this may be to simply increase the number of plants surrounding the sorting bins, other possibilities include creating art installations involving plants that can be placed at eye level. We would further recommend that any replications of this study do not use a green flag as a control condition, but instead use an object that is more common and does not convey any extra and confounding information to the participants. An example of this may be a green wall plank. Finally, we would recommend using hidden video recorders to ensure that each item is accurately recorded.

As noted in our descriptive statistics, the flag condition had the highest average percent of items sorted correctly. This result suggests that a green flag itself may improve the correct sorting of waste. If a flag, by indicating that something is important or different about the sorting bins does improve sustainable waste disposal, then placement of flags at sorting bins that are known to have lower accuracy in sorting behavior may be an effective intervention. However, this possible intervention does have limitations in that the more flags that are introduced, the less important and significant each flag becomes in the eyes of the participants. For this reason, we would recommend only utilizing this solution in areas where correct waste sorting is particularly poor.

## References

Flag. (n.d.). In *Merriam Webster*. Retrieved April 8, 2015, from http://www.merriam-webster.com/dictionary/flag

Griskevicius, V., Cantú, S. M., & Vugt, M. v. (2012). The evolutionary bases for sustainable behavior: Implications for marketing, policy, and social entrepreneurship. *Journal of Public Policy & Marketing, 31*(1), 115-128.

Impacts of pulp and paper production. (n.d.). Retrieved April 8, 2015, from http://wwf.panda.org/about_our_earth/about_forests/deforestation/forest_conversion_agriculture/impactspulppaper/

Nature. (n.d.). In *Merriam Webster*. Retrieved April 8, 2015, from http://www.merriam-webster.com/dictionary/nature

Reducing and reusing basics. (2015, March 11). Retrieved April 8, 2015, from http://www2.epa.gov/recycle/reducing-and-reusing-basics

Schultz, P. W. (2000). Empathizing with nature: The effects of perspective taking on concern for environmental issues. *Journal of Social Issues, 56*(3), 391.

Sorting guide. (n.d.). Retrieved February 27, 2015, from UBC Sustainability website: http://sustain.ubc.ca/campus-initiatives/recycling-waste/sort-it-out/sorting-guide

Van der Wal, A. J., Schade, H. M., Krabbendam, L., & van Vugt, M. (2013). Do natural landscapes reduce future discounting in humans?. *Proceedings of the Royal Society B: Biological Sciences, 280*(1773), 20132295.

Waste action plan. (n.d.). Retrieved April 8, 2015, from UBC Sustainability website: http://sustain.ubc.ca/campus-initiatives/recycling-waste/what-ubc-doing/waste-action-plan

Wu. D. W., DiGiacomo, A., & Kingstone, A. (2013). A sustainable building promotes pro-environmental behavior: An observational study on food disposal. *PLoS One, 8,* e53856.

Zhao, J. (2015), Lecture 16: Climate change and psychology [PowerPoint slides]. Retrieved from University of British Columbia Connect Blackboard System: http://elearning.ubc.ca/connect/

## Appendix A
## Experimental Design and Materials

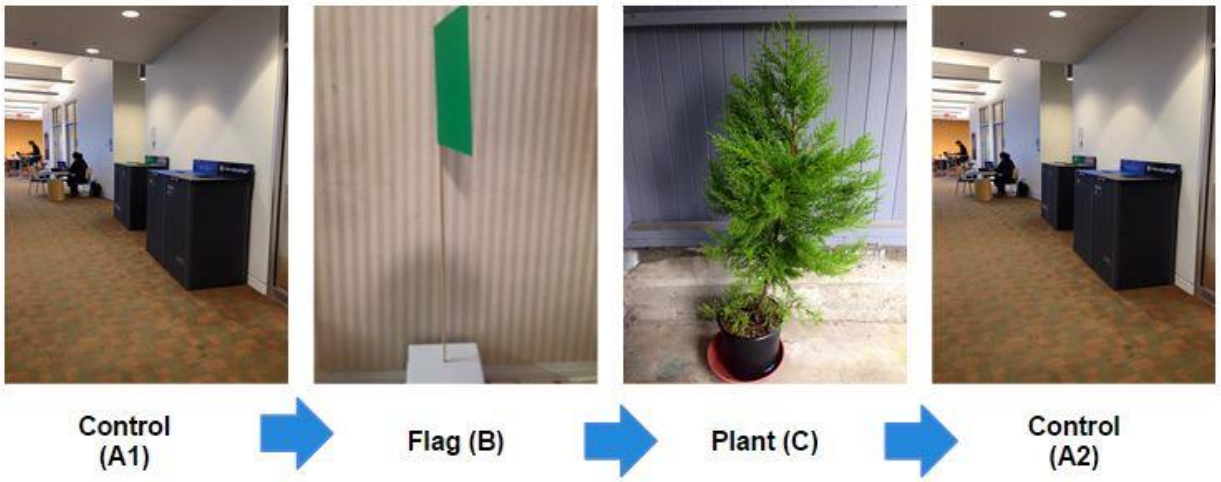


*Figure 1.* Experimental design used.


*Figure 2.* The observed bin stations.

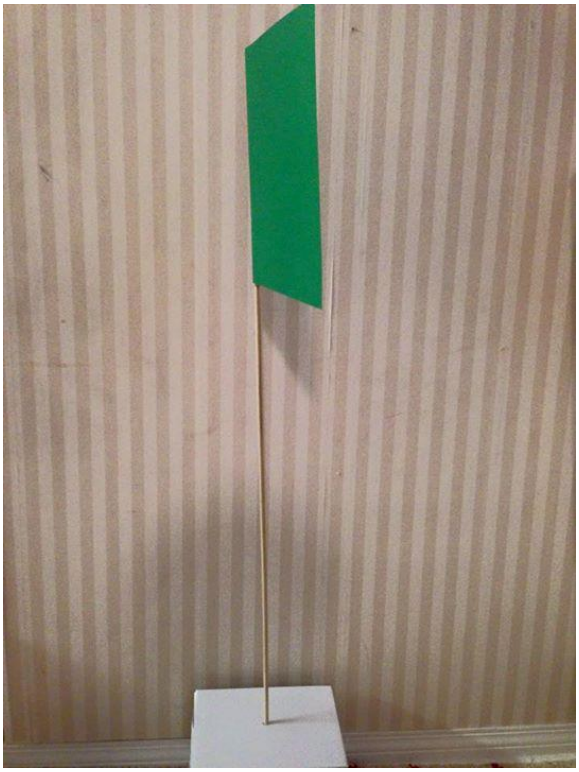

*Figure 3.* Flag.

*Figure 4.* Plant (cypress tree).

| | Key: | C=Correctly sorted item | I = Incorrectly sorted item | | |
|---|---|---|---|---|---|
| **Participant #** | *Green* - **Food Scraps** | *Grey* - **Recyclable Containers** | *Blue* - **Paper** | *Black* - **Garbage** | Notes |
| **1** | | | | | |
| **2** | | | | | |
| **3** | | | | | |
| **4** | | | | | |
| **5** | | | | | |
| **6** | | | | | |
| **7** | | | | | |
| **8** | | | | | |
| **9** | | | | | |
| **10** | | | | | |

*Figure 5.* Coding sheet.

| | **Food Scraps** | **Recyclable Containers** | **Paper** | **Garbage** |
|---|---|---|---|---|
| **Yes** | Cooked food waste<br>Raw fruit, vegetables & grains<br>**Paper towels & napkins**<br>Bones & Egg shells<br>Dairy products<br>Compostable plates<br>Coffee grounds & filters<br>Tea bags<br>Wood chopsticks | Plastic #1 - 7<br>Glass bottles & jars<br>Metal cans<br>Recyclable plastic bottles<br>Recyclable cups & cutlery<br>**Coffee cups & lids**<br>Juice boxes<br>Tetrapak containers<br>Milk cartons | Newspapers & magazines<br>Envelopes<br>Computer paper<br>**Cup sleeves**<br>Cereal boxes<br>Telephone books<br>Sticky notes | Plastic bags<br>Styrofoam<br>Non-recyclable cutlery<br>Waxed paper |
| **No** | **Plastic bags & containers**<br>Coffee cups, lids & | Plastic bags<br>Styrofoam<br>Dishes, glassware | Milk cartons<br>Used paper cups & plates | Anything compostable<br>or recyclable |

| | | | | |
|---|---|---|---|---|
| | sleeves<br>Biodegradable bags<br>All cutlery & plastic chopsticks<br>Diapers | or ceramics<br>Aerosol cans<br>Windows or mirrors<br>Unstamped plastics | Pizza boxes | |

*Figure 6.* UBC's Sort it Out Guide.

## Appendix B
## Tables and Figures

*Table 1*. Descriptive Statistics

| Variable | N | M | SD | SE |
|---|---|---|---|---|
| Plant | 72 | .70 | .42 | .05 |
| Flag | 45 | .81 | .35 | .05 |
| Control | 50 | .78 | .35 | .05 |

*Table 2*. Comparison between Conditions

| Comparison | df | t | p |
|---|---|---|---|
| Plant vs. Flag | 164 | -.40 | .69 |
| Plant vs. Control | 164 | -1.10 | .27 |
| Plant vs. Control and Flag | 164 | -.35 | .73 |
| Flag vs. Control | 164 | 1.50 | .14 |

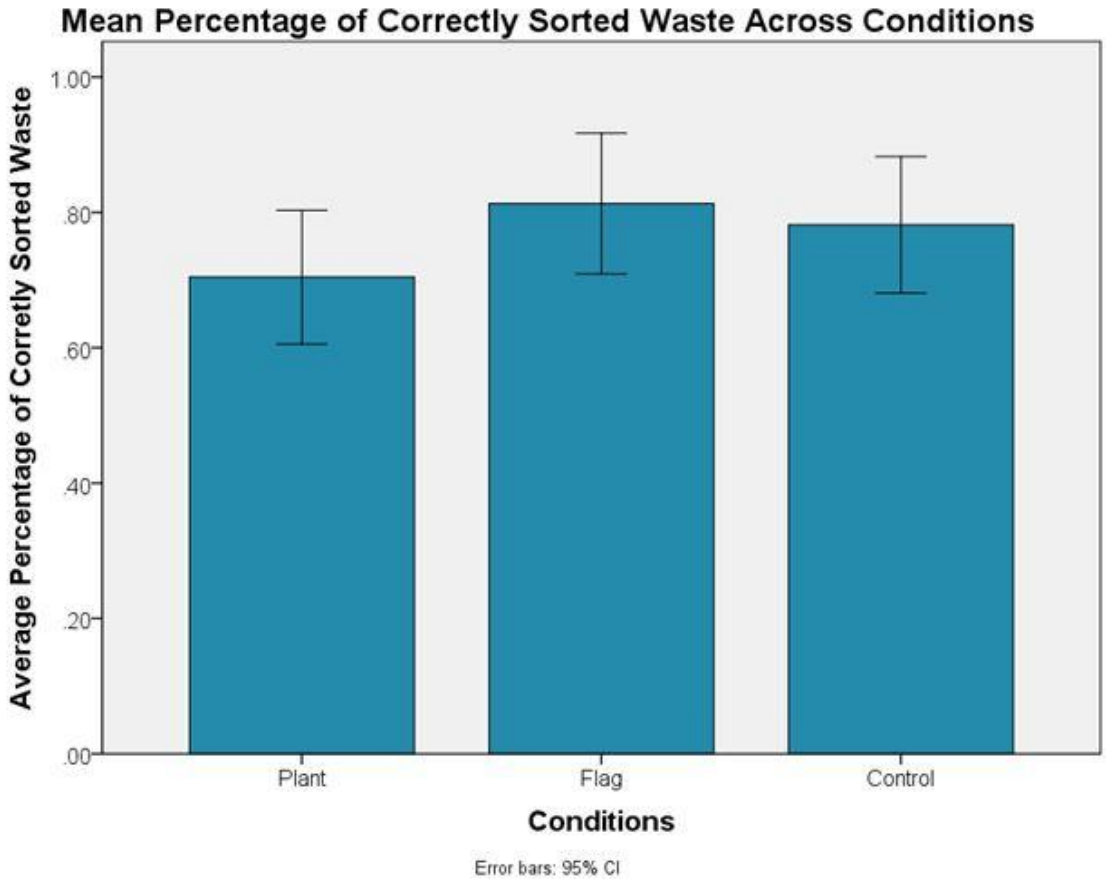


*Figure 7.* The average percentage of waste sorted correctly between conditions.

## Appendix C
## Challenges and Complications

A challenge of our experiment included the location of our observation. Our observation took place at the side area of the Ike's Cafe in the Irving K. Barber Learning Centre of UBC. We found that there was low traffic of participants and although this allowed for better accuracy of our data collection, the lack of sample size was a significant factor in our data analysis. We were constrained to complete our experiment at this particular area due to the presence of other groups running their experiments at the simultaneous time as ours.

At the beginning of our experiment, we were uninformed and uncertain whether we would be provided funding for the purchase of plants nor was there an easily available plant that we could borrow. Due to the work of having to purchase and transport a plant at our own accord, our group was only able to supply one plant to be used for our experiment. This in turn affected the manipulation of our independent variable and may not have allowed to maximize the effects on our dependent variable of correcting sorting behaviour as much. With restricted class schedules and communication delays between our group and the stakeholder, the period of our data collection was narrow and may not have provided the most ideal amount of time for proper observation.